Initiative for Responsible Mining Assurance

Excerpt from the DRAFT Standard for Responsible Mining and Mineral Processing 2.0

Chapter 4.2 – Water Management

Context & Disclaimer on IRMA DRAFT Standard 2.0

IRMA DRAFT Standard for Responsible Mining and Minerals Processing 2.0 is being released for public consultation, inviting the world to join in a conversation around expectations that drive value for greater environmental and social responsibility in mining and mineral processing.

This draft document invites a global conversation to improve and update the 2018 IRMA Standard for Responsible Mining Version 1.0. It is not a finished document, nor seeking final review, but rather is structured to invite a full range of questions, comments and recommendations to improve the IRMA Standard.

This IRMA DRAFT Standard for Responsible Mining and Minerals Processing (v.2.0) has been prepared and updated by the IRMA Secretariat based on learnings from the implementation of the Standard (v.1.0), experience from the first mines independently audited, evolving expectations for best practices in mining to reduce harm, comments and recommendations received from stakeholders and Indigenous rights holders, and the input of subject-specific expert Working Groups convened by IRMA in 2022.

IRMA's Standard has a global reputation for comprehensive in-depth coverage addressing the range of impacts, as well as opportunities for improved benefit sharing, associated with industrial scale mining. This consultation draft proposes a number of new requirements; some may wonder whether IRMA's Standard already includes too many requirements. The proposed additions are suggested for a range of reasons (explained in the text following), including improving auditability by separating multiple expectations that were previously bundled into a single requirement, addressing issues that previously weren't sufficiently covered (e.g. gender, greenhouse gas emissions), and providing more opportunities for mining companies to receive recognition for efforts to improve social and environmental protection.

Please note, expert Working Groups were created to catalyze suggestions for solutions on issues we knew most needed attention in this update process. They were not tasked to come to consensus nor make formal recommendations. Their expertise has made this consultation document wiser and more focused, but work still lies ahead to resolve challenging issues. We encourage all readers to share perspectives to improve how the IRMA system can serve as a tool to promote greater environmental and social responsibility, and create value for improved practices, where mining and minerals processing happens.

The DRAFT Standard 2.0 is thus shared in its current form to begin to catalyze global conversation and stakeholder input. It does not represent content that has been endorsed by IRMA's multistakeholder Board of Directors. IRMA's Board leaders seek the wisdom and guidance of all readers to answer the questions in this document and inform this opportunity to improve the IRMA Standard for Responsible Mining.

IRMA is dedicated to a participatory process including public consultation with a wide range of affected people globally and seeks feedback, comments, questions, and recommendations for improvement of this Standard. IRMA believes that diverse participation and input is a crucial and determining factor in the effectiveness of a Standard that is used to improve environmental and social performance in a sector. To this end, every submission received will be reviewed and considered.

The DRAFT Standard 2.0 is based on content already in practice in the IRMA Standard for Responsible Mining Version 1.0 (2018) for mines in production, combined with the content drafted in the IRMA Standard for Responsible Mineral Development and Exploration (the 'IRMA-Ready' Standard – Draft v1.0 December 2021) and in the IRMA Standard for Responsible Minerals Processing (Draft v1.0 June 2021).

Chapter Structure

BACKGROUND

Each chapter has a short introduction to the issue covered in the chapter, which may include an explanation of why the issue is important, a description of key issues of concern, and the identification of key aspects of recognized or emerging best practice that the standard aims to reflect.

OBJECTIVES/INTENT STATEMENT

A description of the key objectives that the chapter is intended to contribute to or meet.

SCOPE OF APPLICATION

A description of the conditions under which the chapter may or may not be relevant for particular mines or mineral processing sites. If the entity can provide evidence that a chapter is not relevant, that chapter will not need to be included in the scope of the IRMA assessment. A requirement is 'not relevant' if the issue to which a requirement relates is not applicable at the site. For example, requirements related to the use of cyanide would not be relevant at a site at which cyanide is never used.

TERMS USED IN THIS CHAPTER

This is a list of the terms used in the chapter ■ Each term is separated with ■

Terms listed here are identified in the chapter with a dashed underline. And they are defined in the Glossary of Terms at the end of the chapter.

Chapter Requirements

X.X.X. These are criteria headings

X.X.X.X. And these are the requirements that must be met for an IRMA assessment to be issued and subsequently maintained by a site. Most criteria have more than one requirement. All requirements must be met in order to comply fully with the criterion.

a. Some requirements consist of hierarchical elements:
    i. At more than one level.
    ii. Operations may be required to meet all elements in a list, or one or more of the elements of such a list, as specified.

NOTES

Any additional notes related to the chapter and its requirements are explained here.

GLOSSARY OF TERMS USED IN THIS CHAPTER

Terms used in the chapter are defined here.

ANNEXES AND TABLES

Annexes or Tables are found here.

IRMA Critical Requirements

The 2018 IRMA Standard for Responsible Mining v. 1.0 includes a set of requirements identified as being critical requirements. Operations being audited in the IRMA system must at least substantially meet these critical requirements in order to be recognized as achieving the achievement level of IRMA 50 and higher, and any critical requirements not fully met would need to have a corrective action plan in place describing how the requirement will be fully met within specified time frames.

The 2023 updates to the 2018 Standard may edit some critical requirements in the process of revising and therefore there will be a further review specific to the language and implications of critical requirements that follows the overall Standard review.

Associated Documents

This document is an extract of the full DRAFT IRMA FOR RESPONSIBLE MINING AND MINERAL PROCESSING (Version 2.0) – DRAFT VERSION 1.0, released in October 2023 for a public-comment period. The English-language full version should be taken as the definitive version. IRMA reserves the right to publish corrigenda on its web page, and readers of this document should consult the corresponding web page for corrections or clarifications.

Readers should note that in addition to the DRAFT Standard, there are additional policies and guidance materials maintained in other IRMA documents, such as IRMA's Principles of Engagement and Membership Principles, IRMA Guidance Documents for the Standard or specific chapters in the Standard, IRMA Claims and Communications Policy and other resources. These can be found on the IRMA website in the Resources section. Learn more at responsiblemining.net

Comment on the IRMA Standard

> Comments on the IRMA Standard and system are always welcome.
>
> They may be emailed to IRMA at: comments@responsiblemining.net

Additional information about IRMA is available on our website: responsiblemining.net

Chapter 4.2
Water Management

NOTES ON THIS CHAPTER: A number of changes have been made to more closely align the structure and flow of the chapter with other IRMA environmental chapters.

Proposed additions and changes:

- A couple of new requirements related to scoping risks/potential impacts on water from mining-related activities (4.2.2.3, 4.2.2.4)
- Requiring risk assessments to determine which predicted impacts are likely to be significant enough to warrant the development of mitigation measures and to identify contaminants of concern (4.2.2).
- Adaptive management separated from water monitoring program. Adaptive management plan has more detailed requirements (4.2.4), and monitoring program now includes a sampling and analysis plan (4.2.5).
- Modifying the requirement that entities make all monitoring data publicly accessible and requiring that the data be made available in a manner that is more comprehensible to stakeholders and be put into context (4.2.7).
- Moved requirements related to long-term water treatment from Chapter 2.6 into this chapter (4.2.4.3, 4.2.4.4)
- Now reference cyanide and mercury (due to proposed deletion of those chapters)

Note on IRMA Water Quality Tables: We are in the process of reviewing updated water quality standards in different jurisdictions. See note on IRMA Water Quality Criteria by End-Use Tables, at the end of the chapter.

There were two flags in this chapter in the 2018 Mining Standard that have been removed from the proposed updated version. The first flag related to exploring exceptions to IRMA's water quality criteria. There have not been any requests for exceptions in the past five years. The second flag had to do with the cyanide water quality criterion. Entities will have the opportunity to comment on proposed updates to all water quality criteria later this year. IRMA will consider if any flags are needed based on the results of those consultations.

Glossary:

- We are proposing other new/revised definitions for several glossary terms. The 'Terms Used In This Chapter' box shows which terms are new, and the proposed definitions can be found in the glossary at the end of the chapter requirements (and before the Annexes). Feedback on definitions is welcome.

BACKGROUND

Mining-related activities can affect water quality in many ways, including from: the discharge of process effluents water to the environment, seepage through mine wastes to groundwater and surface water, breaches or failures of tailings and water storage facilities, chemical spills, and the release of uncontrolled stormwater.

Remediation of water pollution can be extremely costly. Consequently, the design of systems to prevent any contamination of surface and groundwater should be a primary goal of the mining or mineral processing operation. Responsible entities can minimize water pollution by using a variety of source control approaches including: limiting infiltration of air and water to acid-generating/metal leaching waste and mined materials, using liners and leachate collection systems, collecting mine-influenced water as close to the source as possible, carefully controlling the discharge of stormwater and treated water to the environment, and reducing waste volumes by evaluating options for circularity.

Mines and mineral processing sites are often a large water user for their locale.[1] The impacts of water used by a mining project are highly location-specific, depending on the local climate as well as on competition for water for uses other than mining. In arid regions water scarcity may be a critical concern, whereas in high rainfall regions or areas where the water table is close to the ground surface, challenges arise from the need to pump or divert water in order to develop a mine. The depletion of groundwater, surface water and springs from mine dewatering operations and general water usage by facilities can take decades to replenish after operations cease, and in some instances, groundwater levels and flow directions can be altered indefinitely.

Entities can protect water resources by minimizing the use of water and using water efficiently, ensuring that total withdrawals maintain environmental flows in streams, springs and other surface waters, minimizing groundwater drawdown, and treating mine-influenced water and discharging it in ways that minimize harm to surrounding water users and environmental resources. They can also clean up previously impacted water to make it usable, and in some cases provide a water supply from an alternative source.

Increasingly, responsible entities are aware of their operating context and pay attention not only to their impacts but to their dependencies and opportunities as well. They are participating in collective actions to address shared water challenges and opportunities among diverse stakeholders, and are adopting approaches that lead to positive water management outcomes at the local and regional levels. Such proactive and collaborative identification of potential water quality and quantity issues and the development of suitable management strategies adapted throughout an operation's life cycle can help prevent or minimize surface water and groundwater pollution and impacts on water quantity.

TERMS USED IN THIS CHAPTER

Acid Rock Drainage (ARD) ■ Adaptive Management ■ Affected Community ■ Background Water Quality ■ Baseline (Water Quality) ■ Best Available/Applicable Practices ■ Brine NEW ■ Broad Community Support ■ Closure ■ Collaboration ■ Competent Professionals) ■ Conceptual Site Model (CSM) ■ Consultation ■ Contamination NEW ■ Control ■ Credible Methodology NEW ■ Culturally Appropriate NEW ■ Dewatering ■ Discharge NEW ■ Ecosystem ■ Ecosystem Services ■ Entity NEW ■ Exploration NEW ■ Environmental Flows NEW ■ Facility ■ Free, Prior and Informed Consent ■ Habitat ■ Hazardous Waste NEW ■ Indigenous Peoples ■ Livelihood ■ Long-Term Water Treatment ■ Metals Leaching (ML) ■ Mine-Influenced Water ■ Mineral Processing NEW ■ Mining NEW ■ Mining-Related Activities ■ Mitigation ■ Mitigation Hierarchy ■ Mixing Zone ■ Natural Seep/Spring ■ Offset ■ Operation NEW ■ Pit Lake ■ Point of Compliance ■ Pollution NEW ■ Post-Closure ■ Practicable ■ Project NEW ■ Receptor NEW ■ Reclamation ■ Remediation (Groundwater and/or Soil) NEW ■ Rights Holder ■ Scoping NEW ■ Stakeholder ■ Stormwater ■ Tailings ■ Trigger Level ■ Waste Rock ■ Water Balance ■ Water Quality Criteria ■ Water Quantity

These terms appear in the text with a dashed underline. For definitions see the Glossary of Terms at the end of the chapter.

OBJECTIVES/INTENT OF THIS CHAPTER

To manage water resources in a manner that strives to protect current and future uses of water.

SCOPE OF APPLICATION

RELEVANCE: This chapter is applicable to all exploration, mining and mineral processing projects and operations.

Existing operations (exploration, mines and mineral processing) are also expected to estimate background water quality and quantity where baseline conditions were not previously established (4.2.1.1).

[1] For example, a study in Australia calculated that smelters and acid plants associated with pyrometallurgical production of copper from sulfide feed directly used approximately 10,000 L of water per tonne of copper produced and a further 10,000 L of water indirectly; smelters associated with pyrometallurgical production of nickel from sulfide feed used approximately 5,000 L of water directly and 15,000 L indirectly per tonne of nickel, while refineries used approximately 15,000 L directly and 5,000 L indirectly per tonne of nickel.
For more details, see: Northey, S and Haque, N. 2013. Life Cycle Based Water Footprint of Selected Metal Production: Assessing Production Processes of Copper, Gold and Nickel. https://publications.csiro.au/rpr/download?pid=csiro:EP137374&dsid=DS3

NOTE ON SCOPE OF APPLICATION: This proposed version of the IRMA Standard is meant to apply to exploration, mining, and mineral processing projects and operations (see definitions of project and operation), but not all requirements will be relevant in all cases. We have provided some high-level information below, but the IRMA Secretariat will produce a detailed Scope of Application for each chapter that will indicate relevancy on a requirement-by-requirement basis (and will provide some normative language where the expectations may slightly differ for proposed projects versus operations, or for mining versus mineral processing, etc.).

CRITICAL REQUIREMENTS IN THIS CHAPTER

Adverse impacts are mitigated according to an adaptive management plan (4.2.4.7) and water quantity and quality are being monitored at the site (4.2.5.1) to provide data on whether implemented mitigation measures are effective.

NOTE ON CRITICAL REQUIREMENTS: The 2018 IRMA Standard includes a set of requirements identified as being critical. Projects/operations being audited in the IRMA system must at least substantially meet all critical requirements in order to be recognized at the achievement level of IRMA 50 and higher, and any critical requirements not fully met need a corrective action plan for meeting them within specified time frames.

INPUT WELCOME: The proposed revisions to the 2018 Standard have led to new content, as well as edits of some critical requirements in the process. Therefore, there will be a further review of the language and implications of critical requirements prior to the release of a final v.2.0 of the IRMA Standard. During this consultation period we welcome input on any existing critical requirement, as well as suggestions for others you think should be deemed critical. A rationale for any suggested changes or additions would be appreciated.

Water Management Requirements.

4.2.1. Baseline/Background Water Quality and Quantity

NOTE FOR 4.2.1: This criterion title is new, but the requirement is not. The requirement was previously in a criterion called Site Characterization and Prediction of Potential Impacts (was 4.2.2 in the 2018 Mining Standard).

4.2.1.1. Data on baseline or background water quality and quantity are gathered in sufficient detail to reliably determine project/operation-related sources of contamination and changes in water quantity or quality that are unrelated to the project/operation.[2] Data include:

a. Seasonal and temporal variability in the physical and chemical conditions of surface waters, natural seeps/springs and groundwaters that could be affected by the project/operation, including:
   i. Baseline/background concentrations of the comprehensive suite of parameters in IRMA Water Quality Criteria by End-Use Tables (Tables 4.2.a – 4.2.h) including weak acid dissociable cyanide (if cyanide is used or proposed to be used at the operation);[3] and
   ii. Field parameters (i.e., pH, specific conductance, temperature, and potentially dissolved oxygen and turbidity (in surface waters) and redox potential (in groundwater), measured at the time of baseline/background sampling; and

b. Seasonal and temporal variability in flows and levels of surface waters, natural seeps/springs and groundwaters that could be affected by the project/operation.

[2] Sampling of baseline/background data will be expected to align with the monitoring guidance in Annex 4.2-A (unless entities have a clear and reasonable rationale for using alternative approaches).

[3] This is to establish whether certain constituents are present in the absence of mining activity (i.e., they are naturally occurring, or they are present as a result of third-party activities unrelated to the mineral development project/operation). If baseline data were not collected prior to the commencement of operations, then background data must be collected to estimate likely pre-operational water conditions. For more information see IRMA Standard for Responsible Mining 1.0, Guidance Document (v.1.2). Explanatory Note for 4.2.2.1. Available at: https://responsiblemining.net/resources/#full-documentation-and-guidance

NOTE FOR 4.2.1.1: REVISED. This was 4.2.2.1 in the 2018 Mining Standard. It has been included here to indicate that a baseline water evaluation should be conducted early in the process of mineral development. Ideally, collection of baseline data begins during exploration, but if it was not gathered at that time, the 2018 Mining Standard and the 2023 Standard still expect that some estimation of water background conditions will be determined. The collection of data would be expected to be collected in a manner that aligns with IRMA Water Monitoring Guidance (see Annex 4.2-A).

We deleted biological conditions from 4.2.1.1.a, as the biodiversity baseline is developed in chapter 4.3, requirement 4.6.1.3.

More specificity has been added in 4.2.1.1.a, to make it clear that the baseline data collection should include the full suite of potential contaminants (i.e., those in the IRMA Water Quality Criteria by End Use Tables) to ascertain if any constituents are present even in the absence of mining activity (i.e., either they are naturally occurring, or they are present as a result of third-party activities unrelated to the mineral development project/operation). There is a specific reference to sampling for weak acid dissociable cyanide if cyanide may be or is being used at an operation. That expectation is from requirement 4.7.4.1 in the 2018 Mining Standard.

4.2.2. Scoping Issues and Risks Related to Water

NOTE FOR 4.2.2: NEW. This is a new criterion heading. Scoping is a heading in many other chapters, it has been added here, and relevant requirements have been moved into the section from two other criteria in the 2018 Mining Standard (4.2.1. Water Management Context and Collaboration at the Local and Regional Level and 4.2.2. Site Characterization and Prediction of Potential Impacts). Note that criterion 4.2.1 in the 2018 Standard also contained an additional requirement to take steps to contribute positively to local and regional stewardship outcomes. That requirement has now been moved to the Management of Water section and is requirement 4.2.4.6.

There is no change to the content of requirements 4.2.2.1 and 4.2.2.2, but in the 2018 Mining Standard they were numbered 4.2.1.1 and 4.2.1.2, respectively.

4.2.2.1. Water users, water rights holders and other stakeholders ("stakeholders") that may potentially affect or be affected by project water management practices are identified.

4.2.2.2. The entity conducts its own research and collaborates with relevant stakeholders to identify:

a. How water resources that may be affected by the project/operation are currently being used and how they may be used in the future (e.g., for drinking water, recreation, irrigation, livestock watering, fishing, aquaculture, industrial, etc.); and
b. Water-related concerns, challenges, and opportunities that exist at the local and regional levels.

4.2.2.3. All mining-related activities and facilities that may pose a risk to water quality, including sedimentation risks, from planned discharges or unplanned releases of contaminants of potential concern (COPCs) are identified, including but not limited to:[4]

a. Mine waste facilities (e.g., tailings impoundments, waste rock dumps, slag heaps, heap and dump leach piles, open pits, pit lakes, underground workings, etc.), including catastrophic releases from facility failures;
b. Other types of waste facilities (e.g., hazardous wastes, solid waste landfills, sewage treatment plants);
c. Mineral beneficiation and processing facilities and activities (e.g., crushing/grinding, flotation, heap or vat leaching, mineral processing);

[4] Note that information from Chapter 4.1 (Waste and Materials Management) will be instrumental in identifying the risks to water quality. For example, the scoping process in 4.1.1 will identify chemicals and wastes with hazardous properties and waste facilities (e.g., tailings facilities or landfills, etc.) and project/operation components (e.g., pits, underground workings) that may have the potential to release contaminants to the environment and affect water resources.

Also, information from proposed Chapter 4.X (Management of Physical Stability) will help identify facilities that may be subject to catastrophic failures and releases of materials that could affect the environment and water resources.

b. Evaporation ponds, sedimentation ponds, industrial stormwater retention/detention ponds, pregnant and barren solution ponds, and brine ponds; and
c. General mining activities (e.g., blasting, transport of chemicals and materials, etc.).

NOTE FOR 4.2.2.3: NEW. This requirement has been added because identification of the activities and facilities that may pose a risk to water quality is necessary in order to scope risks to water, and also to develop a conceptual site model (4.2.2.5).

4.2.2.4. All mining-related activities and facilities that pose a risk to groundwater levels, surface water flows, natural seep/spring flows, or environmental flows are identified, including but not limited to risks from:

a. The project's/operation's use and discharges of water;
b. Activities such as groundwater extraction or pumping that may affect water resources; and
c. The presence of open pits, waste facilities, water and brine impoundments, and processing facilities that modify runoff and infiltration of precipitation.

NOTE FOR 4.2.2.4: NEW. This requirement has been added because identification of the activities and facilities that may pose a risk to groundwater levels, surface water flows, natural seep/spring flows, or environmental flows is necessary in order to scope risks to water, and also to develop a conceptual site model (4.2.4.5).

4.2.2.5. A conceptual site model is developed and shared with stakeholders.[5] This model:

a. Includes a detailed description and depiction of the physiography, geology (including structural geology such as faults), hydrology, hydrogeology, climatology, and geochemistry of the site as a whole;[6]
b. Includes all potential mine-related sources of contamination (see 4.2.2.3);
c. Includes all contaminants of potential concern (see Chapter 4.1);[7] and
d. Describes what is known about sitewide contaminant release, transport, pathways between sources and receptors, and fate of contaminants along pathways and in receptors for the site as a whole.[8]

NOTE FOR 4.2.2.5: Minor change. The requirement for a conceptual model was previously 4.1.3.2.c in the Waste Management chapter. It has been moved here due to changes in the structure of that chapter, and because a site-wide conceptual model is important for understanding the big picture of potential sources and fate of contaminants that may affect water quality and quantity. We are proposing that it be shared with stakeholders because it is important for them to have access to this information if they are to understand and participate in discussions on risks to water.

As outlined in the footnote for 4.2.2.5, a conceptual site model should have been developed in the ESIA (Chapter 2.1). But if it was not, it should be developed to inform the scoping of risks to water.

4.2.3. Assessment of Short- and Long-Term Risks to Water

NOTE FOR 4.2.3: NEW. This is a new criterion heading. While implied in the previous version of the water chapter, there were not specific requirements related to how an entity moved from scoping of potential impacts to determining which impacts were likely to be significant enough to warrant the development of mitigation measures. That missing step is risk assessment. Both short-term risks (e.g., during development or operations) and long-term risks (e.g., during closure/post-closure) must be evaluated.

[5] A conceptual site model may have been developed in Chapter 2.1. More detailed conceptual site and facility models are required in 4.2.3.2.

[6] The description and depiction rely on information provided in requirements 4.2.2.1 (baseline), Chapter 4.1 (Waste and Materials Management) requirements 4.1.1.2, 4.1.1.3, and 4.1.1.4 (source material characterization), and proposed Chapter 4.2 (Management of Physical Stability), criterion 4.X.1.

[7] COPCs are identified in requirements 4.1.1.2, 4.1.1.3, and 4.1.1.4.

[8] For example, a scaled map with a clear legend showing the potential sources (e.g., facilities), the location and flow directions in rivers, streams, springs and seeps; the groundwater flow directions; and the locations of major faults.

4.2.3.1. Where potential sources of risks to water quality or water quantity are identified, a credible methodology is used to assess and document the level of risk posed to health, safety, the environment, and current and future uses of water for each identified risk.

NOTE FOR 4.2.3.1: NEW. See note for 4.2.3. This requirement has also been added to be more consistent with the approach in other IRMA chapters, including the ESIA chapter. An assessment of risks/potential impacts on water should have been done as part of the ESIA, but if not done at the appropriate time we are proposing that it needs to be done post-ESIA to ensure that all risks are assessed, to understand the potential consequences related to the risks, and to determine if mitigation measures are required to prevent or mitigate the risks to water quality and quantity.[9]

As mentioned in other chapters, we are proposing to define **credible method/methodology** as:

> A method/methodology that is widely recognized, accepted, and used by experts and practitioners in a particular field of study.

4.2.3.2. Risk assessments, management strategies and reclamation and closure planning (see Chapter 2.6) are informed by the use of the following tools:[10]

a. A conceptual site model (see 4.2.2.5) and conceptual models for facilities;[11]
b. A numeric water balance model for the site as a whole and for each facility that poses a risk to water (as identified in 4.2.2.3) that:
    i. Predicts expected changes in water inflows and outflows (e.g., dewatering rates, water use amounts and sources, treated water discharges) and water volumes stored on-site in facilities (e.g., in supernatant ponds, water management ponds, water in pits) related to the project/operations;
    i. Takes into account the probable maximum precipitation event; low, average, and high precipitation years; and climate change effects on temperature and precipitation using the most reliable, recent, and relevant climate change projections;
    ii. Clearly identifies model assumptions, inputs, and uncertainty; and
    iii. Estimates the effects of water management on groundwater levels and stream/spring flows.
c. Hydrogeochemical and hydrogeological models are used to predict or quantify potential impacts to water resources during all phases of the operation's life cycle (from construction through to post-closure), including estimating concentrations of COPCs at points of compliance.[12]

NOTE FOR 4.2.3.2: REVISED. A conceptual site model was required in 4.2.2.3.a, and conceptual facility models were required in 4.1.3.2.c in the 2018 Mining Standard. Both are now included in 4.2.3.2.a.

4.2.3.2.b was previously 4.2.2.3.b in 2018 Mining Standard. More detail was added to ensure that facility inflows and outflows, climate change, model assumptions, and model uncertainty are identified and handled numerically (with the exception of model assumptions) in the water balance model.

[9] We can add guidance on credible risk assessment methods. For example: https://www.epa.gov/risk/risk-assessment-guidance

[10] The conceptual site model, site water balance and numerical hydrogeochemical or hydrogeological models mentioned in 4.2.3.2 should inform reclamation and closure planning in Chapter 2.6 (Planning and Financing Reclamation and Closure), requirement 2.6.1.1.k (e.g., whether wet or dry closure will be possible, the potential future impacts of climate change on the site, the water quality and quantity at closure, and potential to avoid long-term water treatment).

[11] These facility models would be developed in a manner similar to that for the site model in 4.2.2.5, except for each facility.

[12] Models include, as necessary, groundwater flow models, surface runoff and infiltration models, and/or a combined water balance and load model that can be used alone or in combination to estimate concentrations of COPCs in water resource receptors.

Note: As per Chapter 4.1 (Waste and Materials Management) requirement 4.1.1.3, COPCs from mined material and mine wastes are identified using the results of laboratory short-term and long-term (kinetic) leach tests or results, or as per requirement 4.1.1.4 the results of chemical analysis of extracted brines and liquid wastes. If laboratory leachate, brine or liquid waste concentrations exceed numeric IRMA water quality criteria (Tables 4.2.a – 4.2.h), those constituents are identified as COPCs. The risk assessment will determine final contaminants of concern.

Also, as per requirement 4.1.1.2, for materials coming from third parties to be used as feedstock for mineral processing operations, if the supplier does not disclose to the entity detailed information on the principal components and contaminants that are considered likely to be routinely or periodically present in feed materials, the entity will need to carry out a characterization to determine the characteristics for themselves.

4.2.3.2.c was 4.2.2.3.c in the 2018 Mining Standard. We have added that the predictions from these models extend through all phases of the life cycle, from construction through to post-closure.

4.2.3.3. If, at any time during project development or operations, the concentrations of contaminants in water resource receptors are predicted to exceed both baseline/background water quality and IRMA water quality criteria by end use, or the potential exists for long-term acid rock drainage or contaminant or metal leaching (see Chapter 4.1),[13] the entity:

a. Evaluates whether water treatment will be required to mitigate impacts on water quality during operations and closure/post-closure, including information on contaminants of potential concern and treatment methods and alternatives; and
b. Ensures, if long-term treatment will be required:
    i. The results from the water balance and water quality models are used to estimate the needed timing, volume and duration of water treatment; and
    ii. The risk assessment includes an evaluation of potential consequences to human health, livelihoods, or ecosystems from a failure in long-term water treatment facilities.

NOTE FOR 4.2.3.3: REVISED. 4.2.3.3.a was 4.2.2.3.d in the 2018 Mining Standard. We have added more detail on the conditions that would prompt the evaluation of whether or not long-term water treatment might be needed.

Additionally, we are proposing to add 4.2.3.3.b.i, so that the potential timing of long-term treatment is determined; and 4.2.4.3.b.ii (that the risk assessment include an evaluation of the potential consequences if there is a failure in long-term water treatment). Understanding the potential consequences of a water treatment failure is important information to share with stakeholders as they evaluate any project that will include long-term water treatment (see 4.2.4.3).

4.2.3.4. Conceptual and numeric models are:

a. Developed using credible methodologies; and
b. Evaluated annually using operational monitoring data, and are updated as necessary.[14]

NOTE FOR 4.2.3.4: REVISED. This was 4.2.2.4 in the 2018 Mining Standard. There were two elements in that requirement that were found in a single paragraph. Here, they have been separated into two sub-requirements to make it clear that both elements need to be audited.

In sub-requirement 4.2.3.4.a, the previous requirement used the wording "industry best practices" to describe the development of the models. This has been changed to credible methodologies to be more consistent with expectations elsewhere in the Standard. This term has also been defined (see glossary at end of chapter).

We are proposing a definition for credible methodologies as follows:

Credible Method/Methodology
A method/methodology that is widely recognized, accepted, and used by experts and practitioners in a particular field of study.

In sub-requirement 4.2.3.4.b, we have added that the models are evaluated annually, but that they only need to be updated as necessary.

CONSULTATION QUESTION 4.2-1

[13] E.g., determined by the characterization of mined materials and waste in 4.1.1.3.

[14] This process includes comparing the predicted model results with actual monitoring data and setting parameters for what constitutes acceptable deviations between modeled and actual results. When predicted and actual results do not agree, conceptual and numeric models should be revised and predictions updated to ensure that water management practices are based on the best possible data.

Background: Requirement 4.2.2.5 on a conceptual site model contains the important elements of design for a conceptual facility model. We would also like to create some guidance on credible codes that can be used for water quality/quantity modeling.

The State of Nevada has developed a list that includes most codes commonly used to create numeric hydrogeologic and geochemical models: https://ndep.nv.gov/uploads/land-mining-regs-guidance-docs/20210830_BMRR_CodesListing_Rev01_ADA.pdf. We note that GoldSim is not on the list. Although GoldSim is not technically a computer code and is proprietary, it is frequently used for creating water balance and water balance and load models for mine sites.

Question: Are there other codes or programs that you would recommend including? And should IRMA's list only include credible codes that are publicly available, or also include proprietary programs like GoldSim? What guidance can we offer if the codes or software are proprietary that would assist auditors in their evaluations?

4.2.3.5. Risk assessments are reviewed and, if necessary, updated when there are proposed changes in facilities, activities, extracted materials, and processes, and when there are changes in operational context that have the potential to increase the severity of consequences of any identified risks, or when updates have been made to model predictions.

NOTE FOR 4.2.3.5: NEW. With the proposed addition of a risk assessment this requirement is also necessary, as risk assessment is an ongoing process.

4.2.4. Water Management Planning and Implementation

NOTE FOR 4.2.4: NEW. This is a new criterion heading. In the 2018 Mining Standard, the development of measures to prevent and mitigate impacts to water were included in criterion 4.2.3 Prevention and Mitigation of Impacts to Water. This new criterion combines the mitigation measures with the development of an adaptive management plan for water (previously found in criterion 4.2.4 Monitoring and Adaptive Management). This approach is consistent with other chapters in the IRMA Standard.

4.2.4.1. Measures to manage risks to water quality for all significant risks identified in the risk assessment are:

a. Developed, documented and implemented by competent professionals;
b. Developed in consultation with potentially affected or affected stakeholders in a manner that aligns with the mitigation hierarchy, as follows:
    i. Priority is given to source control and other measures that prevent or avoid the use or generation of contaminants or the release of contaminants, including increased sediment load, relative to baseline conditions;
    ii. Where elimination of contaminants through substitution or source control measures is not practicable or effective, migration control measures are implemented to minimize the movement of contaminants to receptors where they can cause harm to human or ecosystem health; and
    iii. If necessary, polluted waters are captured and treated to remove contaminants and restore water quality before water is returned to the environment or used for other purposes; and
    iv. If prevention and minimization measures are not feasible or do not eliminate impacts, compensation is used as a last resort to offset any remaining impacts; and
c. Align with best available/applicable practices described in Annex 4.2-B.

NOTE FOR 4.2.4.1. REVISED. This requirement, along with 4.2.4.2, replaces requirement 4.2.3.1 in the 2018 version of the IRMA Standard. The previous requirement was very general and therefore difficult to audit consistently. We have elaborated here to provide more detail on what the mitigation hierarchy means for avoidance, minimization/mitigation, restoration, or compensation of impacts to water quality.

Also, we are proposing a new Annex 4.2-B of best-practice measures to minimize risks to water associated with different facilities. The purpose of the annex is to help sites and auditors get a sense of some best practices to safeguard water. Without such guidance, it will be difficult for auditors, who cannot be experts on every type of facility associated with a mining or mineral processing, to confidently or consistently assess whether the mitigation measures being proposed and implemented by sites are consistent with best practices. The current proposal is that entities could either demonstrate alignment with the best practices or provide auditors with a rationale as to why those practices are not appropriate for their situation or provide evidence that alternative approaches are as effective at protecting water.

The proposed content in Annex 4.2-B is a starting point for a conversation. Any input on the approach or the content in the guidance in the annex would be appreciated.

CONSULTATION QUESTION 4.2-2: Do you agree with this approach to create guidance to guide auditor's assessments? If not, how do you suggest auditors determine whether or not the measures at a site are sufficient to safeguard water resources? Would you be interested in being part of a working group to help work on this guidance? If so, please contact IRMA (comments@responsiblemining.net) and we will be in touch as we move forward with this process.

4.2.4.2. Measures to manage risks to water quantity/water supply for all significant risks identified in the risk assessment are:

a. Developed, documented and implemented by competent professionals; and
b. Developed in consultation with potentially affected or affected stakeholders in a manner that aligns with the mitigation hierarchy as follows:
    i. Priority is given to measures that avoid the use or extraction of fresh water, or to measures that avoid activities that adversely affect water resources and the ecosystem services that they support;
    ii. If that is not possible, measures are implemented, as relevant, to reduce the volumes of water used or extracted, or to minimize the water quantity/water supply impacts from other project-related activities on water resources and the ecosystem services that they support; and
    iii. If necessary, affected water supplies and ecosystem services are restored; and
    iv. If other options are not practicable or possible, water supplies are replaced with other sources in a manner that is agreed to by potentially affected or affected stakeholders (see also 4.2.6.2), and any impacts on ecosystems or ecosystem services are offset as per Chapter 4.6.

NOTE FOR 4.2.4.2: REVISED. This requirement, along with 4.2.4.1, replaces requirement 4.2.3.1 in the 2018 version of the IRMA Standard (See Note for 4.2.4.1). We are proposing this language to elaborate on what the mitigation hierarchy means in relation to the mitigation of impacts to water quantity/water supply. Also, 4.2.4.2 will now provide the information needed to audit requirement 4.2.6.2, which requires that if water supplies are affected, there must be stakeholder agreement on any impacts to water supplies.

4.2.4.3. If the need for long-term water treatment is predicted, a proposed project is not developed unless:[15]

a. Risk assessment assumptions and findings are discussed with potentially affected communities; and
b. As relevant:
    i. As per IRMA Chapter 2.3, broad community support is expressed for the project; and/or
    ii. As per IRMA Chapter 2.2, if Indigenous Peoples' rights or interests may be affected by proposed long-term water treatment (including from potential accidents or incidents associated with the treatment facility), the entity obtains the free, prior and informed consent from Indigenous Peoples for the proposed project.

NOTE FOR 4.2.4.3: REVISED. In the 2018 Mining Standard this was requirement 2.6.6.2 in Chapter 2.6—Planning and Financing Reclamation and Closure (criterion 2.6.6 'Post-Closure Water Treatment'), as it related

[15] Chapter 2.6—Planning and Financing Reclamation and Closure also requires that any post-closure long-term water treatment measures must include treatment technologies proven to be effective under similar climatic conditions and at a similar scale to the volume of water that will need to be treated. See requirement 2.6.1.2.k.

to issues that would need to be addressed during post-closure. It has been moved here to keep all of the water-related requirements together.

The overall intent of this requirement has always been that new projects (not existing operations) that will require long-term water treatment only be developed if the risks have been thoroughly understood, disclosed, and discussed with those who will bear the potential consequences should a water treatment failure occur, and that all possible steps be taken to minimize the adverse impacts if a decision is made to proceed with the project.

The 2018 Mining Standard included additional requirements related to an engineering and risk assessment that should take place. Now that a risk assessment requirement exists in the Water Chapter (4.2.3.1), we are proposing to remove those expectations here. However, we have added that the risk assessment must include an evaluation of potential consequences to human health, livelihoods, or ecosystems from a failure in long-water treatment (see 4.2.3.3.b), and have retained that the risk assessment assumptions and findings (and assumptions) be explicitly discussed with affected communities prior to those communities deciding whether to support the project, and that if Indigenous Peoples rights may be affected, risk assessments must be discussed with Indigenous Peoples as part of the free, prior and informed consent process.

We have also removed the sub-requirement that stated that all practicable efforts to avoid/prevent long-term water treatment be taken, as that is included in 4.2.4.1.

Reviewers should note, as well, that there are additional requirements in Chapter 2.6—Planning and Financing Reclamation and Closure that stipulate if long-term water treatment is required there are sufficient funds in place to ensure that treatment operations would be able to continue for as long as necessary to protect water quality. See 2.6.1.4.i and 2.6.3.1.c.

CONSULTATION QUESTION 4.2-3: Do you have any suggestions on alternative language or approaches, or alternative means for safeguarding water resources and those who rely on them if long-term water treatment is necessary, would be welcome.

4.2.4.4. If broad community support is obtained from affected communities and/or Indigenous Peoples provide free, prior and informed consent for a proposed project that requires long-term water treatment (see 4.2.4.3), or if long-term water treatment is deemed necessary at any point during operations:

a. An action plan that contains all the practicable steps that can be taken to minimize the volume of water to be treated is developed and implemented; and
b. The entity demonstrates that funding is in place to implement the actions in 4.2.4.4.a, and to construct, operate and maintain an effective water treatment plant.[16]

NOTE FOR 4.2.4.4: REVISED. In the 2018 Mining Standard this was requirement 2.6.6.2 in Chapter 2.6—Planning and Financing Reclamation and Closure. That requirement stated that all practicable steps shall be taken to minimize the volume of water to be treated.

We have added in 4.2.4.4.a. that an action plan be developed to outline those steps, and also that such a plan be developed if it is discovered at any point during operations that long-term water treatment is going to be necessary (as sometimes early-phase predictions that water treatment will not be necessary are not correct).

And we have added 4.2.4.4.b, that entities demonstrate that such plans are funded, to ensure that such steps are carried out, and that the treatment plant itself needs to be funded.

4.2.4.5. If a surface water or groundwater mixing zone is proposed as a mitigation strategy:

a. A risk assessment is carried out to identify, evaluate and document risks to human health, local economies and aquatic life from use of the proposed mixing zone, including, for surface water mixing zones, an evaluation of whether there are specific contaminants in point source discharges, such as certain metals, that could accumulate in sediment and affect aquatic life (including through bioaccumulation); and

[16] This information should feed into Chapter 2.6, requirement 2.6.1.4.i.

b. If any significant risks are identified, mitigation measures are developed to protect human health, aquatic life and local economies including, at minimum:
    i. Surface water or groundwater mixing zones are as small as practicable;
    ii. Water in a surface water mixing zone is not acutely toxic to aquatic life;
    iii. A surface water mixing zone does not interfere with the passage of migratory fish;
    iv. Surface water or groundwater mixing zones do not interfere with a pre-project use of water for irrigation, livestock or drinking water, unless that use can be adequately provided for through another source of similar or better quality, volume and accessibility, and that this substitution is agreed to by all potentially affected water users; and
c. Discharges into a surface water mixing zone match the local hydrograph for surface water flows to the extent practicable.

NOTE FOR 4.2.4.5: This was 4.2.3.2 in the 2018 Mining Standard.

4.2.4.6. Options to address shared challenges and contribute positively to local and regional water stewardship outcomes are developed through collaboration with relevant stakeholders, and are included in an action plan or equivalent.

NOTE FOR 4.2.4.6: This was 4.2.1.3 in the 2018 Mining Standard.

4.2.4.7. (Critical Requirement)
An adaptive management plan for water (or equivalent) is developed and implemented that:

a. Identifies potential water quality/quantity effects that could occur at monitoring locations, based on the risk assessment (see 4.2.3);
b. Identifies key water quality/quantity indicators that will best characterize the potential effects;
c. Includes trigger levels for water quality and quantity to provide early warning of negative changes in water characteristics;
d. Includes general responsive (adaptive management) actions to be taken if trigger levels or exceedance of legal or other thresholds are reached, and estimated timelines for completion of actions;[17]
e. Assigns implementation of adaptive management actions, or oversight of implementation, to responsible staff;[18]
f. Includes creation of an action plan if exceedance of IRMA Water Quality Criteria (see 4.2.6.1) or another threshold is confirmed. The plan includes:
    i. Determination of the areal extent of the impacts;
    ii. Investigation of the cause/source of the exceedance;
    iii. Evaluation and selection of adaptive management actions developed as per 4.2.4.7.d and/or development of additional or different actions that are likely to correct the exceedance;[19]

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[17] These actions could include: first confirming if the sample results are accurate (see Proposed Guidance below); implementation of measures to regain control of a situation/stop an exceedance/come back into compliance; suspension of mine discharge until water quality meets criteria; reporting within the entity, to government agencies and stakeholders; increase in sampling frequency; changes to monitoring regime, etc.

Proposed Guidance regarding steps to take if water quality trigger levels or thresholds are reached or exceeded in a single sample:

1) The sample is reanalyzed by the laboratory if the sample still exists and meets holding and QA/QC requirements;

2) If the reanalyzed result reaches or exceeds the relevant value, another sample is taken at the same location as quickly as possible, noting any substantial differences in flow, levels, or other characteristics at the site;

3) If resampling confirms concentrations exceed relevant values, the frequency of sampling at that location is increased (e.g., if monthly, sample weekly; if quarterly, sample monthly or more frequently), and the monitoring plan is updated accordingly; and the planned adaptive management actions are implemented.

[18] If work is carried out by third party contractors, there needs to be a staff employee responsible for overseeing quality of work, timelines, etc.

[19] Once a threshold exceedance is confirmed, different or additional actions may be needed than those in the adaptive management plan (in 4.2.4.7.d), because situations may not always unfold as expected, or more may need to be done than was originally anticipated. Often, actions

iv. Development of estimated timeline and budget needed to implement the corrective action plan, and a financing plan to ensure that funding is available for effective implementation of the corrective actions; and

v. Creation of a report summarizing the action plan, the outcome of the response measures taken, and needed changes to improve the effectiveness of implemented mitigation measures identified in 4.2.4.1 and 4.2.4.2.

NOTE FOR 4.2.4.7: REVISED. This was 4.2.4.4 in the 2018 Mining Standard. The requirement has been revised to reflect that there are two broad categories of actions that need to be included in one or more management plan(s). The first, found in 4.2.4.1 (for water quality) and 4.2.4.2 (for water quantity/supply), are the proactive mitigation measures that will be implemented to prevent or minimize impacts on water, such as engineered controls, operational measures, or others. These measures were included in the original requirement, but sub-elements have been added to be more consistent with the expectations regarding management plans in other IRMA chapters.

The second category of actions are the adaptive management actions that are to be taken in response to a situation that affects water quality or quantity (e.g., water quality reaches a trigger level or exceeds a water quality thresholds). The remaining sub-requirements are elements of the adaptive management plan. Entities may choose to have separate water management plans and adaptive management plans if they so choose. In general, separate adaptive management plans are now the norm.

Sub-requirements 4.2.4.7.c and 4.2.4.7.d were 4.2.4.4.b in the 2018 Standard. They have been separated here to ensure that trigger levels are identified (4.2.4.7.c) and response actions to the triggers (4.2.4.7.d) are included in the adaptive management plan and audited separately.

Sub-requirements 4.2.4.7.f is NEW. It was added to emphasize that if trigger levels or thresholds are exceeded in a single sample, adaptive management actions are not required to be implemented until a more thorough evaluation proves whether an exceedance actually occurred. Although quality assurance/quality control measures are included in the sampling and analysis plan (requirement 4.2.5.1.a), laboratory errors are fairly common and should be checked as part of due diligence. Guidance for 4.2.4.7.f will note that the steps to evaluate an individual exceedance should take place as quickly as possible to avoid longer term water impacts.

Sub-requirements 4.2.4.7.g is NEW. It was added for two reasons. First, if there is an exceedance of a threshold related to water quality or water quantity, entities need to determine the extent of the impact. Second, to be clear that it is not uncommon that the initial adaptive management actions (4.2.4.7.d) and mitigation measures (4.2.4.1 and 4.2.4.2) may need to be modified or new actions and measures developed, and that this is acceptable practice as long as they are documented in an adaptive management action plan.

CONSULTATION QUESTION 4.2-4: An adaptive management plan is also required for land and soil management (4.XX.4.3). Should adaptive management plans be required for the management of other resources (e.g., biodiversity, or air)?

4.2.4.8. Annually or more frequently, if necessary, the entity reviews monitoring data and evaluates the effectiveness of the implemented mitigation measures and adaptive management plan actions, and, as necessary, develops new mitigation measures and/or revises the adaptive management plan to improve water management outcomes.

NOTE FOR 4.2.4.8: This was 4.2.4.5 in the 2018 Mining Standard. Minor clarification has been added that an evaluation of the effectiveness of mitigation measures and review of the monitoring results are part of the review of the adaptive management plan.

are more specific to the observed exceedance. Examples of actions include: installing groundwater pumping wells downgradient of a waste rock pile, improving removal of arsenic in a treatment plant, increasing the freeboard of the barren solution pond to avoid overtopping, etc.

4.2.4.9. Stakeholders in affected communities are provided with the opportunity to review adaptive management plans and provide feedback on revisions to the plans.[20]

NOTE FOR 4.2.4.9: This was 4.2.4.6 in the 2018 Mining Standard.

4.2.5. Water Monitoring Program

NOTE FOR 4.2.5: Monitoring was previously combined with Adaptive Management in the 2018 Mining Standard (criterion 4.2.4). Ideally a water monitoring program should be designed and implemented before mining-related activities begin, and then expanded during operations. Monitoring results inform scoping and assessment of risks to water (Criteria 4.2.2 and 4.2.3) and adaptive management. Although a monitoring program is needed as early as possible in a project, positioning it here and before the comparison of monitoring results to water quality/quantity criteria is consistent with its placement in other chapters.

4.2.5.1. (Critical Requirement)
A program to monitor effects on water quantity and quality is developed and implemented that:

a. Includes a sampling and analysis plan (or equivalent) that is consistent with best practices (see Annex 4.2-B Annex 4.2-B) and includes:
   i. Sample collection, handling and transportation protocols, sample hold times, analysis, quality assurance/quality control methods (e.g., collecting replicate, trip blank, and equipment blank samples), and reporting requirements;
   ii. A sufficient number of monitoring locations at sites unaffected by the project (baseline locations) and sites potentially affected by the project to provide reliable data on changes to water quantity, including environmental flows, and the physical and chemical conditions of surface waters, natural seeps/springs and groundwater (hereafter referred to as water characteristics);
   iii. Collection of water quality and quantity samples on a frequent enough basis to account for seasonal fluctuations, storm events and extreme events that may cause changes in water characteristics;
   iv. Analysis of water quality samples for field parameters and all other parameters that have a reasonable potential to adversely affect identified current and future water uses, including, if relevant, cyanide and mercury;[21] and
   v. Analysis of water quality samples in laboratories using equipment capable of detecting contaminants at levels below the values in the relevant IRMA Water Quality Criteria by End-Use Tables.

b. Includes sampling and analysis of the comprehensive suite of parameters in relevant IRMA Water Quality Criteria by End-Use Tables at points of compliance every five years, at a time of year when concentrations are expected to be the highest, to determine if unanticipated contaminants may be present (e.g., due to changes in ore, waste, or brine characteristics as operations progress); and

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[20] As per 4.2.7.5, adaptive management issues are discussed with the entity on an annual basis, or more frequently if requested by stakeholders.

[21] Field parameters include pH, temperature, specific conductance, and potentially dissolved oxygen, redox potential and turbidity.

'Parameters with a reasonable potential to adversely affect identified current and future water uses' are based on baseline (see requirement 4.2.1.1) and geochemical characterization results (See criterion 4.1.1 in Chapter 4.1) and the IRMA water quality criteria by end use tables (Tables 4.2.a – 4.2.h).

Where the entity can demonstrate that there is no reasonable potential for a parameter to exceed the baseline/background values or numeric criteria in the IRMA Water Quality Criteria by End-Use Tables, those parameters only need to be measured in samples every five years as per 4.2.2.1.b. The entity can demonstrate that there is no reasonable potential, for example, if baseline or background monitoring do not detect the parameter, and source characterization, modeling, and other site-specific information indicate no/low probability that the parameter will be detected.

Note that if cyanide is likely to be used at the site (see 4.1.6.1) then water samples at compliance locations would need to be monitored for weak acid dissociable (WAD) cyanide. If WAD cyanide is detected in discharges to surface waters, the entity would also monitor total cyanide, free cyanide, and thiocyanate levels. NOTE: these expectations are from requirements 4.2.7.1 and 4.2.7.2 in the 2018 Mining Standard.

If mercury is released to air or disposed on-site (see 4.1.6.2.d) then inorganic mercury (total and dissolved) and methyl mercury and sulfate are sampled in wetlands and water bodies located on or downwind of the operation and at compliance locations regardless of identified current and future water uses, and methylmercury is monitored in tissue, stream sediment and locations most likely to promote methylation, such as still waters, wetlands, and anaerobic sediment. NOTE: this was requirement 4.8.3.2.b in the 2018 Mining Standard.

c. Includes sampling of water quality and documentation of the quantity of mine-influenced waters destined for re-use by external third-party entities.

NOTE FOR 4.2.5.1: REVISED. This requirement includes elements from 4.2.4.1 and 4.2.4.2 in the 2018 Mining Standard because both contained elements of the water monitoring program. The numbering has changed (4.2.5.1.a.ii was 4.2.4.1.a; 4.2.5.1.a.iii was 4.2.4.1.b; 4.2.5.1.a.iv was 4.2.4.2; 4.2.5.1.a.v was 4.2.4.1.e and f.). In the 2018 Mining Standard requirement 4.2.4.1 was a critical requirement, and we have carried over that designation (for more on critical requirements see the note that accompanies 'Critical Requirements In This Chapter,' above).

Also, following modifications are noted:

- Some content in 4.2.5.1.a is REVISED. Reference to a sampling and analysis plan was added because all credible water monitoring programs have sampling and analysis plans to guide collection, handling, transport, analysis, and reporting. This was not clear in the 2018 Standard.
- Added more detail in 4.2.5.1.a.i, which, in addition to more detailed best practices for water quality and quantity monitoring (included as Annex 4.2-B) will improve the auditability of the requirement. Guidance will also be developed on some of the core elements of monitoring best practices to help sites and auditors know what important elements must be implemented to meet the IRMA requirement.
- 4.2.5.1.a.ii was modified to include environmental flows. There may be enough flow in a river to meet the needs for human uses, but leave aquatic ecosystems unsustainable, especially if environmental flows are disrupted for significant periods or during particularly sensitive times. Monitoring flows with this in mind will be important for understanding impacts. We are proposing a definition of environmental flows to align with IUCN definition: "the water provided within a river, wetland or coastal zone to maintain ecosystems and their benefits where there are competing water uses and where flows are regulated." For more information on the monitoring of environmental flows see, for example: Dyson, M. et al. 2008.[22]
- 4.2.5.1.a.iv now includes reference to cyanide and mercury because we are proposing to delete Chapter 4.7 on Cyanide and Chapter 4.8 on Mercury Management and integrate the requirements into other relevant chapters so that auditors with specialty in water, air, soils, etc., are able to evaluate the requirements alongside other water, air and soil requirements, rather than having a single auditor cross the different areas of expertise.
- In 4.2.5.1.a.v, a reference to accredited laboratories, was removed because in many parts of the world there may not be a national program for laboratory accreditation. However, we retained the requirement that the laboratories used must have the ability to detect parameters at concentrations below IRMA water quality criteria.
- 4.2.5.1.b is NEW. Previously this was a recommendation in IRMA Guidance for requirement 4.2.4.2. The rationale for sampling for the full suite of relevant potential contaminants is to evaluate whether a contaminant has unexpectedly appeared in water.

CONSULTATION QUESTION 4.2-5: We do not currently have any prescribed frequency for sampling. We are considering requiring that samples be collected and analyzed monthly unless there is a legitimate reason for a different sampling frequency, but would appreciate feedback on this topic.

CONSULTATION QUESTION 4.2-6: At the present time, IRMA does not have any water quality criteria for rare earth elements (REEs). We would be interested in knowing of any international or national water quality standards for REEs. If none exist, should IRMA still require that rare earth mining and processing operations at least measure certain elements as part of their characterization of ores, wastes, brines, and concentrates (see Chapter 4.1, 4.1.1) to, at minimum, establish a baseline? If so, which elements should be monitored?

[22] Dyson, M., Bergkamp, G. and Scanlon, J., (eds). 2008. Flow – The essentials of environmental flows, 2nd Edition. Gland, Switzerland Available at: https://protosh2o.act.be/VIRTUELE_BIB/Werken_in_het_Water/IWB-Integraal_WaterBeheer/W_IWB_E44_flow_essentials.pdf

4.2.5.2. The monitoring program is reviewed annually, and updated as needed (e.g., if there are changes in ore, waste, or brine characteristics, available monitoring locations, or water or waste management practices).

NOTE FOR 4.2.5.2: NEW. The 2018 Mining Standard did not call for an annual review of the monitoring program (only of the adaptive management plan). Both will change as the mine progresses, and so we are proposing to add an annual review to the monitoring program here, as well.

Also, because this proposed updated Standard includes more references to lithium brine extraction and processing, and because the chemical composition of brines can change over time, a reference to brine characteristics is added to this requirement.

4.2.5.3. Stakeholders from affected communities are actively solicited by the entity to participate in water monitoring and to review and provide feedback on the water monitoring program:

a. Participation may involve the use of independent experts selected by the community; and
b. If requested by community stakeholders, costs related to participation in monitoring and review of the monitoring program are covered in full or in part by the entity, and a mutually acceptable agreement for covering costs is developed.

NOTE FOR 4.2.5.3: This was 4.2.4.3 in the 2018 Mining Standard.

4.2.6. Comparison of Monitoring Results to Water Quality/Quantity Criteria

NOTE FOR 4.2.6. This is a NEW criterion heading. It was previously in a criterion called Prevention and Mitigation of Impacts to Water (4.2.3). That criterion name no longer exists due to restructuring of this chapter.

4.2.6.1. Water quality monitoring results demonstrate that parameters/contaminants measured at points of compliance are:[23]

a. Being maintained at baseline or background levels, which in some cases could exceed IRMA Water Quality Criteria; or
b. Being maintained at levels that are protective of the identified uses of those waters (see IRMA Water Quality Criteria by End Use-Tables 4.2.a to 4.2.h, which correspond to particular end uses); or
c. Being maintained at levels or conditions according to host country regulatory requirements that are lower (more protective) than IRMA Water Quality Criteria for identified uses, or that fill gaps where no IRMA Water Quality Criteria exist.

NOTE FOR 4.2.6.1: This was 4.2.3.3 in the 2018 Mining Standard. Language has been slightly amended, but the intent is still the same.

4.2.6.2. Water quantity monitoring results demonstrate that surface waters, groundwater levels, natural seep/spring flows and environmental flows are being maintained in a manner that supports continued current and potential future uses of the water resources and the ecosystem services that they support,[24] unless affected stakeholders have agreed that some decline in flows or water levels is acceptable.[25]

NOTE FOR 4.2.6.2: This requirement was 4.2.3.4 in the 2018 Mining Standard and has been revised to include environmental flows. (See note for 4.2.5.1.a.ii for more background on environmental flows.)

4.2.7. Reporting and Disclosure of Water Management Performance

4.2.7.1. The results of the baseline or background water quantity and quality evaluation for surface water, natural seep/springs, and groundwater are publicly available.

[23] Note that if this requirement is not met, then corrective actions would need to be developed as part of the adaptive management plan for water. See requirement 4.2.4.7.f.

[24] As identified in collaboration with relevant stakeholders (see 4.2.2.2).

[25] The acceptability of some reduction in flows would have been determined through consultations with affected stakeholders that happened in 4.2.4.2.b. If this requirement is not met, then corrective actions should be developed as part of the Adaptive Management Plan.

NOTE FOR 4.2.7.1: This requirement used to be combined with the following requirement in criterion 4.2.5 of the 2018 Mining Standard. We are proposing to separate the requirements, because baseline/background values are established either before mining or during mining and those values hold steady, although the monitoring sites originally identified as baseline or background locations could become influenced by mining activity over time.

4.2.7.2. Summaries of water data are published and shared with stakeholders from affected communities on a monthly basis. The summaries:

a. Present information in a culturally appropriate format, and in a manner that is understandable to affected communities;
b. For water quality:
    i. Present data using graphical or other suitable representations that clearly show whether parameters measured at monitoring locations are the same as, higher than, or lower than IRMA water quality criteria;[26] and
    ii. Put any deviations from criteria into context, taking into consideration likely stakeholder concerns regarding risks to human health and impacts on the environment.
c. For water quantity:
    i. Present data on flows and levels for surface waters and natural seeps/springs, groundwater level/elevation, and the volume of water discharged and extracted for use by the project/operation using graphical or other suitable representations that clearly show whether the flows, levels, and volumes are the same as, higher than, or lower than baseline/background and agreed-upon values;
    ii. Put any deviations from baseline/background and agreed-upon values into context, taking into consideration likely effects on aquatic life habitat and conditions (environmental flows) and water quantity amounts needed to maintain domestic, community, and local commercial water supplies.

NOTE FOR 4.2.7.2: This requirement is NEW. In discussions with the Water Expert Working Group in 2022, there was general agreement that rather than requiring sites to create systems to make all data accessible, it would be more useful if data were regularly made available in a manner that is comprehensible to stakeholders, and that data need to be put into context so that the information does not create concern where none may be warranted, but also daylights issues of non-compliance with regulatory and IRMA standards when they occur.

We have prepared some examples of how data could be presented. They are available here: https://responsiblemining.net/wp-content/uploads/2023/07/4.2.7.2WaterGraphExamples.pdf

CONSULTATION QUESTION 4.2-7: Do you know of best practice examples of how water data are shared with affected communities? We would be interested in seeing those examples so that we can provide ample guidance to entities seeking to meet this requirement.

4.2.7.3. An access to information (or equivalent) policy that allows stakeholders to access the following data upon request is in place and shared with stakeholders:

a. Water quality monitoring data for surface water and groundwater points of compliance; and
b. Monitoring data for water quantity (i.e., flows and levels of surface waters, natural seeps/springs and groundwater, and the volume of water discharged and extracted for use by the project/operation).

NOTE FOR 4.2.7.3: REVISED. This requirement was 4.2.5.1 in the 2018 Mining Standard.

It has been revised. The previous requirement said that all monitoring data in 4.2.5.1.a and b needed to be published annually. The revised requirement still expects that these data are provided to stakeholders <u>if requested</u>, but we are proposing to remove the obligation that <u>the raw</u> data be published annually. It is not reasonable to expect that auditors will be able to adequately review the voluminous raw data for a site, and

[26] Baseline/background, permit limits and/or trigger levels could be added to graphs if requested by affected stakeholders.

graphs or other visual displays required in 4.2.7.2, above, will be easier for auditors to evaluate, especially if relevant IRMA water quality criteria are included on the displays. Also, the information in 4.2.7.2 will be more comprehensible to stakeholders.

However, there may still be some stakeholders that want the detailed information, and so we have retained the requirement that they be able to access the information. Note that the requirement for an access to information policy (or equivalent) is being proposed in Chapter 1.2. See that chapter for more information.

4.2.7.4. Effective procedures for rapidly communicating with relevant stakeholders in the event that changes in water quantity or quality occur that pose an imminent threat to human health or safety, or commercial or natural resources, are developed and tested in collaboration with stakeholders from affected communities.

NOTE FOR 4.2.7.4: Added that the procedures are developed and tested with stakeholders. This is consistent with the requirements in IRMA Chapter 2.5 - 'Emergency Preparedness and Response.'

4.2.7.5. Water quality management strategies and performance and adaptive management issues are discussed with relevant stakeholders on an annual basis or more frequently, if requested by stakeholders.

NOTE FOR 4.2.7.5: This was 4.2.5.3 in the 2018 Mining Standard.

NOTES

None.

CROSS REFERENCES TO OTHER CHAPTERS

This table will be added when the new content for all chapters is finalized and approved.

GLOSSARY OF TERMS USED IN THIS CHAPTER

PROPOSED NEW DEFINITIONS

Brine

Groundwater, surface water or sea water that contains valuable dissolved minerals at sufficient concentrations to be economically extractable.

Contamination

The presence of a substance where it should not be or at concentrations above background, but not necessarily high enough to have an adverse impact on ecosystem and/or human health. See also 'Pollution'.

Source: Chapman, P. 2006. "Determining when contamination is pollution," Environ. Int. https://doi.org/10.1016/j.envint.2006.09.001

Contaminant of Potential Concern (COPC)

Contaminants that may pose a risk to human health or non-human biological receptors (e.g., plants, animals).

Credible Method/Methodology

A method/methodology that is widely recognized, accepted, and used by experts and practitioners in a particular field of study. (See Proposed Glossary Additions at the end of the chapter).

Culturally Appropriate

Refers to methods, formats, languages, and timing (e.g., of communications, interactions, and provision of information) being aligned with the cultural norms, practices, and traditions of affected communities, rights holders, and stakeholders.

Discharge

A permitted release of treated mine-influenced water or compliant water to surface water, groundwater, or the land. See, also, 'Release'.

Entity

A company, corporation, partnership, individual, or other type of organization that is effectively in control of managing an exploration, mining or mineral processing project or operation.

Exploration

A process or range of activities undertaken to find commercially viable concentrations of minerals to mine and to define the available mineral reserve and resource. May occur concurrent with and on the same site as existing mining operations.

Environmental Flows

The water provided within a river, wetland or coastal zone to maintain ecosystems and their benefits where there are competing water uses and where flows are regulated.

Hazardous Wastes

Wastes with properties or characteristics that make them a physical, health, or environmental hazard.

Mineral Processing

Activities undertaken to separate valuable and non-valuable minerals and convert the former into an intermediate or final form required by downstream users. In IRMA this includes all forms of physical, chemical, biological and other processes used in the separation and purification of the minerals.

Mining

Activities undertaken to extract minerals, metals and other geologic materials from the earth. Includes extraction of minerals in solid (e.g., rock or ore) and liquid (e.g., brine or solution) forms.

Operation

The set of activities being undertaken for the purpose of extracting and/or processing mineral resources, including the running and management of facilities and infrastructure required to support the activities, and the ongoing legal, environmental, social and governance activities necessary to maintain the business endeavor.

Pollution

Contamination that results in or can result in adverse biological effects to human or ecosystem health. All pollutants are contaminants, but not all contaminants are pollutants. See also 'Contamination'.

Project

The development phases before a mining or mineral processing operation can begin (e.g., exploration, pre-feasibility, feasibility, conceptual design, planning, permitting). Includes all desk-top and field-based activities, including exploration activities, needed to inform and develop a project proposal, support the environmental and social impact assessment of a proposal, generate information necessary to fulfill regulatory and permitting requirements, engage with stakeholders and rights holders, and maintain the entity's business endeavor.

Receptor

Any human, plant, animal, or structure which is, or has the potential to be, affected by the release or migration of contaminants.

Reclamation

The process of achieving stability, hydrologic balance and converting disturbed land and/or water resources to a productive post-mining (or post-mineral processing) land use, or establishing the potential for productive use.

Components of reclamation may include: removal or isolation of hazardous material and waste, decommissioning and removal of buildings and other structures, removal and disposal of polluted soils, adjustment and stabilization of landforms (e.g., earthwork including backfilling, grading, recontouring, stormwater controls), creation of suitable conditions for the introduction of desired flora and fauna (topsoil placement, revegetation, ecological restoration), and any other planned mitigation (e.g., wetlands construction, water diversion, other).

Release

An unintentional, unpermitted emission of mine-influenced water to the environment. See, also, 'Discharge'.

Remediation (Groundwater)

The treatment of contaminated groundwater to remove contaminants or convert them to harmless products. Ex-situ groundwater remediation is the most commonly used approach (with the remediated water being replaced underground following treatment), but in-situ treatment may be possible in some cases.

Remediation (Soil)

The treatment of contaminated soils to remove contaminants or convert them to harmless products using physical, chemical and biological processes. Ex-situ and in-situ remediation of soils are both commonly applied methods. Soil remediation may also include removal and deposition in repository.

Scoping

The process of determining potential issues and impacts and producing information necessary to inform decision-making regarding whether additional evaluation and actions are necessary.

Site

An area that is owned, leased, or otherwise controlled by the entity and where mining-related activities are proposed or are taking place.

EXISTING DEFINITIONS

Acid Rock Drainage (ARD)

The drainage produced when rocks with sulfide or other acid-producing minerals are under oxidizing conditions (exposed to water and oxygen) and generate an acidic water stream. Acid rock drainage generally contains elevated concentrations of metals, sulfate, and other constituents and has a $pH < 6$. The terms acid mine drainage and acid and metalliferous drainage (both AMD) are sometimes used as synonyms for ARD.

Adaptive Management

A structured, iterative process of robust decision-making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring. It includes the development of management practices based on clearly identified outcomes, and monitoring to determine if management actions are meeting desired outcomes. If outcomes are not being met, the process requires development and implementation of management changes to ensure that outcomes are met or re-evaluated.

Affected Community

A community that is subject to risks or impacts from a project/operation.

REVISED. Changed wording from project to project/operation.

Background Water Quality

Established after an operation has commenced, it is the water quality in a similarly mineralized area outside of the operation's influence (e.g., surface water quality upstream of the mine site or upgradient for groundwater).

REVISED. Changed wording from mining to operation.

Baseline (Water Quality)

The water quality at the site or in the area surrounding a proposed mining or mineral processing operation, before construction of the operation commences.

Best Available/Applicable Practice (BAP)

Encompasses management systems, operational procedures, techniques and methodologies that, through experience and demonstrated application, have proven to reliably manage risk and achieve performance objectives in a technically sound and economically efficient manner. BAP is an operating philosophy that embraces continual improvement and operational excellence, and which is applied consistently throughout the life of a facility, including the post-closure period.

Broad Community Support (BCS)

A collective expression by the community in support of the mining project. Support may be demonstrated through credible (i.e., transparent, inclusive, informed, democratic) local government processes or other processes/methods agreed to by the community and entity. There may be BCS even if some individuals or groups object to the business activity.

Closure

Refers to the post-reclamation activities that are required to close and secure a site to maintain compliance with environmental and health and safety regulations. It includes interim fluid and site management in addition to post-reclamation monitoring and maintenance during the period when the success of reclamation measures to achieve site-safety, stability, revegetation, and water quality as well as other reclamation objectives is measured and maintained. The closure period is finite and typically no more than ten years in duration.

REVISED. Changed term from 'Mine Closure' to 'Closure', as the term can also apply to stand-alone mineral processing facilities, and some language changed to be less mining-specific.

Collaboration

The process of shared decision-making in which all stakeholders constructively explore their differences and develop a joint strategy for action. It is based on the premise that, through dialogue, the provision of appropriate information, collectively defined goals, and the willingness and commitment to find a solution acceptable to all parties, it is possible to overcome the initially limited perspectives of what is achievable and to reach a decision which best meets the interests of the various stakeholders. At this level, responsibility for decision-making is shared between stakeholders.

Competent Professionals

In-house staff or external consultants with relevant education, knowledge, proven experience, and necessary skills and training to carry out the required work. Competent professionals would be expected to follow scientifically robust methodologies that would withstand scrutiny by other professionals. Other equivalent terms used may include: competent person, qualified person, qualified professional.

REVISED. Deleted reference to Chapter 4.1.

Conceptual Site Model (CSM)

A qualitative description, based on site measurements and observations, of what is known about the release, transport and fate of contaminants at a site or facility. A CSM includes a schematic or diagram and an accompanying narrative description.

REVISED. Added that CSM can also apply to a facility.

Consultation

An exchange of information between a company and its stakeholders that provides an opportunity for stakeholders to raise concerns and comment on the impacts and merits of a proposal or activity before a decision is made. In principle, the company should take into account the concerns and views expressed by stakeholders in the final decision.

Control

An act, object (engineered), or system (combination of act and object) intended to prevent or mitigate an unwanted event.

Ecosystem

A dynamic complex of plant, animal, and micro-organism communities and their non-living environment interacting as a functional unit.

Source: United Nations Environment Programme, Convention on Biological Diversity 1992, Art. 2. Available at

Ecosystem Services

The benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling.

Facility

Refers to any land, building, installation, structure, equipment, conveyance, or area that alone or together serve a particular purpose. In the IRMA Standard, the term may be associated with a specific type of facility that is self-described (e.g., tailings facility), but other examples of facilities are open pits, access roads, water dams, waste disposal sites, underground mine workings, beneficiation plants, brine ponds, slag piles, etc. See also 'Associated Facility'.

REVISED. Updated to be more descriptive.

Free, Prior and Informed Consent (FPIC)

Consent based on: engagement that is free from external manipulation, coercion and intimidation; notification, sufficiently in advance of commencement of any activities, that consent will be sought; full disclosure of information regarding all aspects of a proposed project or activity in a manner that is accessible and understandable to the people whose consent is being sought; acknowledgment that the people whose consent is being sought can approve or reject a project or activity, and that the entities seeking consent will abide by the decision.

Habitat

A terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment. The place or type of site where an organism or population naturally occurs.

Indigenous Peoples

An official definition of 'Indigenous' has not been adopted by the UN system due to the diversity of the world's Indigenous Peoples. Instead, a modern and inclusive understanding of 'Indigenous' includes peoples who: identify themselves and are recognized and accepted by their community as Indigenous; demonstrate historical continuity with pre-colonial and/or pre-settler societies; have strong links to territories and surrounding natural resources; have distinct social, economic ,or political systems; maintain distinct languages, cultures, and beliefs; form non-dominant groups of society; and resolve to maintain and reproduce their ancestral environments and systems as distinctive peoples and communities. In some regions, there may be a preference to use other terms such as tribes, first peoples/nations, aboriginals, Adivasi, and Janajati. All such terms fall within this modern understanding of 'Indigenous'.

REVISED. Removed the term "ethnic groups" as this is broadly applicable to other populations that are not considered Indigenous Peoples and could make it challenging to audit.

Livelihood

The full range of means that individuals, families, and communities utilize to make a living, such as wage-based income, agriculture, fishing, foraging, other natural resource-based livelihoods, petty trade, and bartering.

Long-Term Water Treatment

Long-term water treatment is defined as any water treatment that requires active water treatment after mine closure. After mine closure long-term water treatment is assumed to be required until it can be empirically demonstrated that water treatment is no longer needed.

Metals Leaching

The release of metals by contact with solvents. Leaching may be natural or induced (e.g., related to mining operations). Mining commonly accelerates metal leaching. Metals leaching can also be referred to as "contaminant" leaching.

Mine-Influenced Water

Any water whose chemical composition has been affected by mining or mineral processing. Also referred to as mine-impacted waters. Mine-influenced waters can contain elevated metal concentrations and acidity that have leached from mined materials (e.g., waste rock, tailings, mine surfaces, or mineral surfaces in their pathways), but mine-influenced water also includes neutral mine drainage and saline drainage, as well as water affected by blasting, metallurgical process waters, industrial stormwater, and dewatering water.

REVISED. Previously Mining Impacted Waters. Previously focused on waters influenced by mine wastes. Now includes more examples of mine-influenced waters.

Mining-Related Activities

Any activities carried out during any phase of the mineral development life cycle for the purpose of locating, extracting and/or producing mineral or metal products. Includes physical activities (e.g., land disturbance and clearing, road building, sampling, drilling, airborne surveys, field studies, construction, ore removal, brine extraction, beneficiation, mineral or brine processing, transport of materials and wastes, waste management, monitoring, reclamation, etc.) and non-physical activities (e.g., project or operational planning, permitting, stakeholder engagement, etc.).

REVISED. Added reference to mineral development life cycle, project/operation, brine.

Mitigation

Actions taken to reduce the likelihood of the occurrence of a certain adverse impact.

Mitigation Hierarchy

The mitigation hierarchy is a set of prioritized steps to alleviate environmental (or social) harm as far as possible first through avoidance, then minimization (or reduction), followed by restoration of adverse impacts. Compensation/offsetting are only considered to address residual impacts after appropriate avoidance, minimization and restoration measures have been applied.

Mixing Zone

A volume of surface water or groundwater containing the point or area of discharge and within which an opportunity for the mixture of wastes with receiving surface waters or groundwaters has been afforded, and where water quality is allowed to exceed otherwise specified standards.

Natural Seep/Spring

A natural seep is a moist or wet place where water reaches the earth's surface from an underground aquifer. Seeps are usually not of sufficient volume to be flowing much beyond their above-ground location.

A natural spring is a discharge of water formed when the side of a hill, a valley bottom or other excavation intersects a flowing body of groundwater at or below the local water table, below which the subsurface material is saturated with water. A natural spring is differentiated from a seep in that water flows at a greater rate from an aquifer to the earth's surface.

Offset

An activity undertaken to counterbalance a significant residual impact.

Pit Lake

Lake formed in a mine pit when mine dewatering pumpage ceases.

Point of Compliance

For IRMA purposes, is the physical location where water quality must meet IRMA used-based standards (See IRMA Water Quality By End-Use Tables 4.2.a – 4.2.h). The location will vary based on the following scenarios:

Surface water compliance points are located where point source discharges enter surface waters. Points of compliance for non-point-source discharges are located downstream of but as close as practicable to known mine-related nonpoint sources.

Groundwater compliance points are located outside the groundwater capture zone (which extends from the land surface to the depth at which groundwater is not affected by mining activities) or area of hydrologic control for mine facilities or sources but as close as practicable to those sources.

Stormwater compliance locations in industrial stormwater collection impoundments when water is present.

If a mixing zone is used, the point of compliance is at the downstream or downgradient edge of the mixing zone. The edge of the mixing zone is where the diluted plume meets background water quality. In no case shall mine-related contaminants extend beyond the mine boundary, unless a mixing zone authorized by a regulatory agency extends beyond the boundary.

If a mine is providing water to another entity for a designated use, the water must meet IRMA use-based standards, or legal documentation must be received from the entity verifying that they will be responsible for treating water to meet use-based standards.

Post-Closure

The period after reclamation and closure activities have been completed, and long-term management activities (e.g., ongoing monitoring and maintenance, and, if necessary, water management and treatment) are occurring to ensure that a site remains stable and ecological restoration objectives continue to be achieved. This phase continues until final sign-off of site responsibility and relinquishment of post-closure financial assurance can be obtained from the regulator.

REVISED. Changed to be less focused on financial assurance and provide more description of the activities that are taking place.

Practicable

Practicable means giving equal weight to environmental, social, and economic benefits and costs. This is not a technical definition. It is the discussion between the affected parties on the balance between these interrelated costs and benefits that is important.

Rights Holder

Rights holders are individuals or social groups that have particular entitlements in relation to specific duty bearers (e.g., state or non-state actors that have a particular obligation or responsibility to respect, promote and realize human rights and abstain from human rights violations). In general terms, all human beings are rights-holders under the Universal Declaration of Human Rights. In particular contexts, there are often specific social groups whose human rights are not fully realized, respected or protected.

Stakeholders

Individuals or groups who are directly or indirectly affected by a project/operation, such as rights holders, as well as those who may have interests in a project/operation and/or the ability to influence its outcome, either positively or negatively.

REVISED. Changed wording from persons to individuals, and from project to project/operation.

Stormwater

Industrial stormwater (also known as contact water) is rainfall, snow or snowmelt runoff that has contacted mined or mineral processing materials (e.g., waste rock, tailings, mine openings, open pits, mineral processing facilities and associated mining roads). Non-industrial stormwater (also known as non-contact water) is rainfall, snow or snowmelt runoff from land and impervious surface areas that do not contain and are not affected by mined or mineral processing materials.

REVISED. Now also references mineral processing.

Tailings

The waste stream resulting from milling and mineral concentration processes that are applied to ground ore (i.e., washing, concentration, and/or treatment). Tailings are typically sand to clay-sized materials that are considered too low in mineral values to be treated further. They are usually discharged in slurry form to a final storage area commonly referred to as a tailings storage facility (TSF) or tailings management facility (TMF).

Trigger Level

A concentration between baseline or background values and IRMA water or soil quality criteria or other applicable compliance limits that can warn of mining or mineral-processing-related effects to water or soil quality and trigger adaptive management or corrective actions to improve water or soil quality.

REVISED. Now also references soil quality and mineral processing.

Waste Rock

Barren or mineralized rock that has been mined but is of insufficient value to warrant treatment and, therefore, is removed ahead of the metallurgical processes and disposed of on site. The term is usually used for wastes that are larger than sand-sized material and can be up to large boulders in size; also referred to as waste rock dump or rock pile.

Water Balance

An accounting of the inflow to, outflow from, transfers and storage changes of water over a fixed period.

Water Quality Criteria

Numerical concentrations or a narrative statement recommended to support and maintain a designated water use. Criteria are based on scientific information about the effects of water pollutants on a specific water use.

Water Quantity

For IRMA purposes, water quantity refers generally to the amount of water present or passing a certain location in water bodies that exist on the earth's surface, such as lakes, ponds, rivers, streams, etc., (i.e., referred to as surface waters) and water bodies that exist underground (i.e., groundwaters). It also includes the amount of water that originates underground but expresses itself at the surface (e.g., natural springs or seeps). Water quantity measurements may be expressed as volumes, however, for IRMA's purposes measurements for rivers, streams and natural springs/seeps maybe expressed as a flow (in ft^3/sec or m^3/sec), while measurements for lakes and groundwater may be expressed as a level or elevation (e.g., feet or meters above a reference point such as sea level).

IRMA Water Quality Criteria by End-Use Tables

Note on IRMA Water Quality Tables: We are in the process of reviewing updated water quality standards in different jurisdictions. Our intention is to update the IRMA Water Quality Criteria by End Use Tables, including adding in parameters that have relevance to lithium brine and mineral processing operations, as well as rare earth mining operations. When we have completed the review we will propose updates (as necessary) and we will release the tables for public review and comment.

The 2018 IRMA Water Quality Tables are available at: https://responsiblemining.net/wp-content/uploads/2018/08/IRMA_WATER-QUALITY-TABLES_2018.pdf

CONSULTATION QUESTION 4.2-8: Are you interested in reviewing the updated water quality tables? If so, please contact IRMA (comments@responsiblemining.net) and we will make sure you receive a copy of proposed updates.

ANNEX 4.2-A: Water Monitoring and Reporting Guidance

Note on Annex 4.2-A: This guidance has been prepared to help sites and auditors understand what are best practices for water monitoring and reporting related to large-scale mining and mineral processing operations. Guidance in the Annex 4.2-A was sourced from the U.S. Geological Survey, the U.S. Environmental Protection Agency, the State of New Mexico and others. References are provided at the end of Annex A.

The guidance provided in Annex 4.2-A should be applied when collecting baseline water samples (4.2.1. Baseline/Background Water Quality and Quantity Assessment) and in requirement 4.2.5.1, the critical requirement in 4.2.5 Water Monitoring Program. Annex A contains guidance on locating and documenting water monitoring sites; creation of a sampling and analysis plan; water sample collection, handling, and transport protocols for surface water and groundwater quality; measurement of surface water and spring flows and groundwater levels; and reporting requirements. Taken together, these elements constitute a water monitoring program and field sampling and analysis plan (FSAP).

An example FSAP for surface water can be found at this link: https://responsiblemining.net/wp-content/uploads/2023/07/Chapter.4.2.ExampleFieldSamplingAnalysisPlan.pdf.

CONSULTATION QUESTION 4.2-9: Is there any content in the guidance that you do not believe is best practice? Are there other elements of water monitoring programs that should be included?

1. Locating and Documenting Water Monitoring Sites

Water monitoring sites are located in areas not affected by mining-related activity and releases (for baseline and background sites) and in areas potentially affected by mining-related activity and releases (for assessment sites). The conceptual site model in Section 4.2.2.5 will be used to identify appropriate baseline/background and assessment monitoring locations. A scaled map with a clear legend showing the location of all monitoring sites relative to potential sources (e.g., facilities) will be created as part of the monitoring plan. The location and flow directions in rivers, streams, springs and seeps; the groundwater flow directions; and the locations of major faults will be plotted and depicted on the map(s) and considered when siting monitoring locations.

1.1. Baseline and background monitoring locations

a. Baseline monitoring sites must be located upstream or upgradient of facilities and potential areas of impact, or, for background monitoring, in reference locations with similar hydrology, geology, and mineralization as the Project site.

1.2. Assessment monitoring locations

a. Proximal groundwater and surface water assessment monitoring sites will be located as close as practicable around the perimeter and downgradient of each facility at the mine site. Each proximal site shall take into account surface topography, hydrogeologic conditions, geologic controls, infrastructure, engineering design plans, depth to groundwater, working distance, and safety.

b. Additional monitoring sites will be located downgradient and downstream of the proximal sites to determine the potential spatial extent of project-influenced water.

c. Groundwater monitoring sites will also be located at different depths to determine the potential vertical extent of project-influenced water.

1.3. Timing of installation and initial sampling of monitoring sites

a. For a new project or new facility, the monitoring networks shall be installed at least 180 days before emplacement of any process water or waste materials to allow sampling prior to discharge.

b. For expansion of existing project or the footprint of an existing facility, monitoring around and downgradient of the facility/facilities must begin before emplacement of waste material unless an existing monitoring network adequately monitors water quality and quantity/level in the area of the facility.

c. Initial sampling of new monitoring sites shall be monthly or more frequent.

1.4. Monitoring location information

a. The entity shall provide a table showing: the monitoring site identification code; type of monitoring site (surface water, seep/spring, groundwater); name of the stream or project area where the site is located; date of installation of the monitoring site; locations of the monitoring sites (latitude/longitude); for groundwater sites, the total depth, screened interval, well diameter, elevation of the ground surface and the measuring point (e.g., top of casing), lithologic log and construction information; and the monitoring purpose of each location (e.g., baseline/background, downgradient of tailings facilities).

b. Monitoring location information shall be updated annually, or as often as new sites or modifications of existing sites occur.

2. Sampling and Analysis Plan

2.1. Use of competent professionals

a. The sampling and analysis plan must be created by competent professionals.

b. All sample collection, handling, preservation, and laboratory analysis must be conducted by competent professionals.

2.2. Elements of the sampling and analysis plan

a. A general sampling and analysis plan for water will have the following sections. The information in the sections can be short and contained in tables, but each section should be included.

   i. Objectives and overview (e.g., to determine the potential effects of the project on water quality, stream and spring flows, and groundwater elevations over the life of the project)

   ii. Sampling and analysis schedule (frequency and approximate dates of field sampling and laboratory analysis)

   iii. Types, numbers, and locations of samples to be collected (using a table that shows the sample type (e.g., total metals, anions, field/equipment blank, replicate), bottle size (mL), whether sample will be filtered and if so where (field or lab)

   iv. Map showing sampling locations and identifiers, including streams, project facilities, highways, etc.

   v. Sample identification and labeling to be used (labels for bottles conveying the sample identification code, sample date and time, sample matrix (water or sample type), preservative used (if relevant), filtered/unfiltered, analyses required.

vi. Field sampling protocols (sample site selection and marking, sample collection methods, field parameter measurement methods, sampling filtering methods (if applicable), preparation of field/equipment/trip blanks and replicates

vii. Field documentation (bound field sheets for each location or a dedicated field notebook with the following information: site and project name, samplers' names, data and time of sample collection, sample identification, stream or spring flow measurements and depth to groundwater, listing of samples collected at each location, results of field parameter measurements, deviations from field sampling plan and reasons, description of each photograph taken)

viii. Decontamination procedures (if not using disposable sampling equipment)

ix. Sample preservation, storage, shipping, and custody (sample preservation included in a table, e.g., 1% concentrated nitric acid added to metals samples; samples stored in coolers on ice until arriving at laboratory, if needed; shipping method to laboratory; chain-of-custody27 (sheets, often provided by the analytical laboratory, that include project name, identifier for each sample bottle and analyses requested, date and time of collection, name and signature of samplers, date and time of shipping, shipping mode)

x. Analytical measurements: a table showing the parameters to be determined, laboratory analytical methods to be used for each parameter and sample type, and detection limits for each parameter. Detection limits must be lower than relevant IRMA water quality criteria (according to IRMA requirement 4.2.5.1.a.v).

3. General Requirements for Water Quality and Quantity/Level Sampling

3.1. Sampling frequency

a. Water quality and quantity sampling will take place often enough to account for seasonal fluctuations, storm events, and extreme events that may cause changes in water characteristics.

b. Sampling will be informed by meteorologic events (e.g., storms, snowmelt) that control precipitation and stream and spring/seep flows and by changes in project water balance.

3.2. Surface water quality and flow sampling

a. For collection of surface water quality samples from streams or surface waters with obvious flow, the following procedure will be used:

i. The sampler should wear waders and rubber or neoprene gloves.

ii. Depending on the safety of flow conditions, the sampler will enter the stream downstream of the sampling location and proceed upstream to the sampling point. If stream flows are unsafe, samples will be collected from the bank using a dipper or other device with an extended handle to allow safe collection of the sample.

iii. The sampling gloves should be rinsed in ambient water for 10 seconds.

iv. For bottles without added preservative (e.g., acid):

- After uncapping the sample bottle, the sampler will face upstream and lower the inverted bottle into the stream so that a minimum of water enters the bottle. Samples will be collected from mid-depth or from as deep a depth as possible, given safety constraints.
- When the bottle has been lowered, the sampler will rotate the bottle so that the open end faces upward, thus allowing water to fill bottle. Partially fill the bottle with water, then remove the bottle from the water and cap immediately. Shake the bottle to coat all surfaces with ambient water. Remove cap and pour out water. Repeat three times. Fill the bottle completely after rinsing with ambient water for the third time, remove from the water, and cap immediately.

[27] The documentation of a sample's history (from time of collection through sample analysis to final disposal) is referred to as "chain of custody." Much of the information on the chain of custody sheets is derived from the bottle labels and field sheets.

- The procedures in steps iv. and v. will be repeated as necessary for any replicate samples.

v. For bottles with added preservative or if the water depth is too shallow to immerse a sample bottle, a disposable beaker or 1-L pre-cleaned bottle will be used to transfer water from the stream to the sample bottle. The beaker or 1-L bottle will be rinsed three times in ambient water. Do not fill the sample bottle to overflowing.

vi. For samples collected from diversion pipes or spigots on tailraces, the sample bottles will be filled directly from the water stream without inverting the sample bottle and will be rinsed three times in ambient water. Rubber or neoprene gloves rinsed for 10 seconds in ambient water will be worn while collecting the sample.

b. For measurement of stream flow:

i. Stream flows will be measured using standard U.S. Geological Survey (USGS) methods for gauging flow (http://water.usgs.gov/pubs/twri/). If possible, flow measurements will be made in the location that the water quality sample is collected. However, if more suitable section of stream is present within a few hundred feet, and no significant recharge or discharge to the stream is observed along the reach, the streamflow measurements may be taken slightly upstream of downstream of the location where the water quality sample is collected. All locations where flow measurements are made will be described using a hand-held GPS.

ii. Stream flow will be measured by one of the following methods at each location: velocity measurement using flow meters; velocity measurement using floats; or direct volume measurement.

Velocity measurement using flow meters: Discharge in stream reaches near sensitive stream areas (e.g., upstream of fish hatcheries) will be measured using a portable flow meter. The stream cross section will be segmented into vertical subsections, and the mean velocity will be estimated by making velocity measurements along the verticals. If the depth of the river is > 2.5 ft (0.76 m), velocities will be measured at 0.2 and 0.8 of the depth below the surface (Buchanan and Somers, 1969). For stream depths between 0.3 and 2.5 ft (0.09 and 0.76 m), velocity measurements will be made at the 0.6 depth, i.e., 60% of the total distance from the surface of the water to the streambed. Discharges will be computed using these measurements using standard methods (Buchanan and Somers, 1969; Church and Kellerhals, 1970). In general, the area and velocity for each vertical subsection are multiplied and then summed for each section:

$$Q_s = \Sigma (a_i v_i)$$

where: Q_s = stream flow
$a_{i.}$ = cross-sectional area of vertical subsection i
v_i = average velocity measured for vertical subsection i.

Velocity measurement using floats: If the stream cannot be safely waded, an estimate of discharge will be made using a float. A suitable float will be placed in the river, and the surface velocity of the river estimated by timing the passage of the float along a reach. The stream cross section will be estimated using whatever measurements can be safely made with respect to stream width and depth. The stream flow will be calculated using standard equations (Buchanan and Somers, 1969; Church and Kellerhals, 1970). For a round float, stream flow is calculated by:

$$Qs = 0.85\ A\ v$$

where: Qs = flow in the stream
A = cross-sectional area of the stream
V = measured surface velocity of the float.

Direct volume measurement: If flows are too low or too shallow to use a current meter, flows will be measured with a container of known volume and a stopwatch. Flow will be collected into the container, and the time to fill the container to a specific level will be measured.

3.3. Groundwater quality and level sampling

a. Measure the depth to groundwater
   i. Measure from the top of the well casing to the nearest 0.1 cm (0.01 ft) using an electronic water level indicator, pneumatically or by using a fiberglass or steel measuring tape using the chalk method, or other similar method.
b. Purge monitoring well
   i. Purge three well volumes of water using conventional methods before sample collection.
   ii. Purge the monitoring well using low-flow purging methods until measurements of indicator parameters have stabilized. Use a low-flow pump and a low-stress approach, micro-purge method or minimal drawdown method. Measure indicator parameters periodically during purging. Record the results in a parameter stabilization log during each sampling event for each monitoring well and include: date; water quality indicator parameter measurements; time for all measurements; and the purge volume extracted.
   iii. For low yield wells, purge the well of all available water.
c. Measure and record the following field parameters: pH, specific conductance, temperature, and redox potential (if applicable).
d. Collect the groundwater sample.
e. Preserve, store, and transport the groundwater samples to an analytical laboratory for analysis.

References

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ANNEX 4.2-B: Best Practices to Manage Water Risks Associated with Various Facilities

NOTE FON ANNEX 4.2-B: The purpose of the annex is to create a resource of best practices to safeguard water. IRMA is proposing this Annex because many jurisdictions lack the regulatory requirements or guidelines and professional personnel to ensure facilities are designed and operated to protect water resources. Thus, without such guidance, it will be difficult for auditors, who cannot be experts on every type of facility associated with a mining or mineral processing, to confidently or consistently assess whether the mitigation measures being proposed and implemented by sites are consistent with best practices.

The current proposal is that entities could either demonstrate alignment with the best practices or provide auditors with a rationale as to why those practices are not appropriate for their situation or provide evidence that alternative approaches are as effective at protecting water (e.g., existing regulatory requirements may be sufficient, or there may be technical or other valid site- or facility-specific reasons to utilize alternatives).

The practices contained in this section were derived from the New Mexico Copper Rule: https://www.srca.nm.gov/chapter-6-water-quality/. The intent of the rule was to provide industry prescriptive requirements consistent with current best practice and technology to facilitate a more efficient and effective permitting application and approval process.

The rule was developed by the New Mexico Ground Water Quality Bureau in 2012 to supplement permitting requirements for Copper Mining Facilities. It was developed with input from industry, environmental and other stakeholders and is based in large part on existing guidance and regulations including Arizona's Best Available Demonstrated Control Technology (BADCT),[28] Nevada, Alaska and other U.S. State water protection regulations, and the Global Acid Rock Drainage Guide.[29]

These practices offer a starting point for IRMA's guidance. We recognize that there may be other jurisdictions with guidance that may be as good or better than what we have proposed. Any input on the approach or the content in the Annex would be appreciated.

CONSULTATION QUESTION 4.2-2 (repeated from above): Do you agree with this approach to create guidance to guide auditor's assessments? If not, how do you suggest auditors determine whether or not the measures at a site are sufficient to safeguard water resources? Would you be interested in being part of a working group to help work on this guidance? If so, please contact IRMA (comments@responsiblemining.net) and we will be in touch as we move forward with this process.

Contents

[28] Arizona Department of Environmental Quality. 2004. Arizona Mining Best Available Demonstrated Control Technology (BADCT) Guidance Manual. https://static.azdeq.gov/wqd/badctmanual.pdf

[29] International Network for Acid Prevention. 2014. Global Acid Rock Drainage Guide. http://www.gardguide.com/index.php?title=Main_Page

1. IMPOUNDMENTS (other than tailings impoundments)

<table>
<tr><th colspan="2">MATERIAL CHARACTERIZATION</th></tr>
<tr><td></td><td>• See Chapter 4.1.</td></tr>
<tr><th colspan="2">IMPOUNDMENT ENGINEERING DESIGN</th></tr>
<tr><td>Outside slopes</td><td>• Slope = a maximum of two (horizontal) to one (vertical)
• Minimum static factor of safety of 1.3 with water impounded to the maximum capacity design level, except where an impoundment is bounded by rock walls or is below the surrounding surface grade</td></tr>
<tr><th colspan="2">IMPOUNDMENT LOCATION</th></tr>
<tr><td>Separation between impoundments and ground water</td><td>• Impoundments that require a liner are not be constructed in a location where the vertical distance between the seasonal high groundwater level and the finished grade of the floor of the impoundment is less than or equal to four feet unless an engineering evaluation from a licensed professional engineer demonstrates that the impoundment design will not be affected by shallow ground water conditions.</td></tr>
<tr><th colspan="2">IMPOUNDMENT CAPACITY</th></tr>
<tr><td>Impoundments that contain leach solutions</td><td>• Any impoundment that collects leach solutions and is routinely at capacity is designed to maintain a minimum of two feet of freeboard during normal operating conditions while conveying the maximum design process flows
• Overflow capacity:
o Impoundment is designed for adequate overflow capacity for upset conditions such as power outages, pump or conveyance disruptions and significant precipitation events.
o The appropriate overflow capacity design considers system redundancies such as backup power systems and pumps.
o The overflow capacity is designed to contain the maximum design flows for the collection system for the maximum period of time that is required for maintenance activities or restoration to normal operating conditions while maintaining two feet of freeboard.
o If the collection system receives direct precipitation run-off with little or no flow attenuation in the upgradient source, the overflow capacity shall be sized to contain the runoff from a 200-year, 24-hour storm event in addition to the upset condition capacity.
• For process water impoundments located within an open pit surface drainage area, the open pit bottom may be utilized for a portion of the impoundment capacity.
• Impoundments constructed on a Facility such that any overflow would discharge to and be contained by the Facility containment system are not subject to this capacity requirement.</td></tr>
<tr><td>Impoundments that contain process water other than leach solutions[30]</td><td>• Designed to maintain a minimum of two feet of freeboard during normal operating conditions while conveying the maximum design process flows.
• Overflow capacity:
o Designed for adequate overflow capacity for upset conditions such as power outages, pump or conveyance disruptions and significant precipitation events.
o The appropriate overflow capacity design considers system redundancies such as backup power systems and pumps.
o The overflow capacity is designed to contain the maximum design flows for the collection system for the maximum period of time that is required for maintenance activities or restoration to normal operating conditions while maintaining two feet of freeboard.
• For process water impoundments located within the open pit surface drainage area, the open pit bottom may be utilized for a portion of the permitted impoundment capacity.
• Impoundments intended to dispose of a combination of process water and impacted stormwater are designed to contain, at a minimum, the volume described above and the</td></tr>
</table>

[30] "Process water" means any water that is used to process ore using hydrometallurgical extraction techniques. It commonly contains process chemicals. Examples include: leachate collected from waste rock stockpiles, leach stockpiles, and tailings impoundments; tailings decant water; pit dewatering water; intercepted ground water, laboratory or other waste discharges containing water contaminants; raffinate; and domestic wastes mixed with process water.

	volume of stormwater runoff and direct precipitation generated from the receiving surface area resulting from a 200-year return interval storm event while preserving two feet of freeboard. • Impoundments constructed on a facility such that any overflow would discharge to and be contained by the facility containment system are not subject to this capacity requirement.
Evaporative impacted stormwater impoundment[31]	• Impoundments intended to manage or dispose of impacted stormwater by evaporation are designed to contain, at a minimum, the volume of stormwater runoff and direct precipitation generated from the receiving surface area resulting from a 200-year return interval storm event while preserving two feet of freeboard. • For impoundments located within the open pit surface drainage area, the open pit bottom may be utilized for a portion of the impoundment capacity.
Other impacted stormwater impoundment[32]	• Designed to prevent overflow resulting from a 200-year return interval storm event while maintaining two feet of freeboard and may use interconnected impoundments, gravity flow conveyances and pumping systems designed to remove water from individual impoundments at rates to prevent overflow during the design storm event. • Overflow capacity: o Design considers system redundancies such as backup power systems and pumps. • For impacted stormwater impoundments located within the open pit surface drainage area, the open pit bottom may be utilized for a portion of the permitted impoundment capacity.
Stormwater conveyance structures	• Open channel conveyance structures intended to transport stormwater to an impoundment are designed to convey, at a minimum, the peak flow from a 200- year return interval storm event while preserving adequate freeboard, but not less than six inches of freeboard. • Conveyances are designed to minimize ponding and infiltration of stormwater.
IMPOUNDMENT LINER AND LEAK COLLECTION SYSTEMS	
Process water, and impacted stormwater impoundments that store impacted stormwater for longer than thirty days[33]	• **Liner system.** At a minimum, impoundments are designed and constructed as an engineered liner system consisting of a suitable subgrade and liner bedding overlain by a secondary synthetic liner which is overlain by a leak collection system overlain by a primary synthetic liner, unless an alternate design is justified. **An alternative design** would need to provide the same or greater level of containment as a double synthetically lined system with leak collection. • **Liner system sub-grade and bedding.** The liner system is placed upon a stable sub-grade that is free of sharp rocks, vegetation and stubble to a depth of at least six inches below the liner are placed on a liner bedding of sand or fine soil. The surface in contact with the liner is smooth to allow for good contact between liner bedding. The liner bedding surface is sufficiently dry during liner installation such that free or excess water will not hinder the welding of seams. The liner installer provides the entity with a sub-grade and liner bedding acceptance certificate prior to installing the liner indicating acceptance of the earthwork. • **Liner type.** The primary and secondary synthetic liners for the impoundment provide the same or greater level of containment, including permeability, as a 60 mil HDPE geomembrane liner system. The liner system's tensile strength, tear and puncture resistance and resistance to degradation by ultraviolet light are compatible with design loads, exposure and conditions. • **Leak collection system.** A leak collection system is constructed between the primary and secondary synthetic liners for the purpose of collecting and rapidly removing fluids from leaks that may occur in the primary liner so that minimal hydraulic head is maintained on the secondary liner. The leak collection system consists of a drainage layer, fluid collection pipes and a fluid removal system to prevent hydraulic head transference from the primary liner to the secondary liner and shall meet the following requirements.

[31] Impacted stormwater" means direct precipitation and runoff that comes into contact with water contaminants at an operation that causes the stormwater to exceed one or more IRMA water quality criteria. Includes overflow from a primary process solution impoundment or other collection system resulting from a precipitation event.

[32] Ibid.

[33] **EXCEPTION:** process water and impacted stormwater long-term impoundments located within an open pit surface drainage area of an existing operation may be designed and constructed in accordance with the requirements of 'Impacted stormwater impoundments that store impacted stormwater for less than 30 days'.

	o The drainage layer is constructed of granular soil materials or geosynthetic drainage net (geonet) with a design slope of at least two percent. Drainage materials have a coefficient of permeability of 1x10-2 centimeters/second or greater. o Perforated fluid collection pipes are installed to transmit fluid from the drainage layer to a fluid collection sump(s). Collection pipe material, diameter, wall thickness, and slot size and distribution are sufficient to prevent deflection, buckling, collapse or other failure. Collection pipes are installed with slopes equivalent to the slope of the drainage layer. Collection pipe systems are designed to allow for cleaning of all collection pipes with standard pipe cleaning equipment. o A fluid removal system is installed to remove fluid from the leak collection system. The fluid removal system consists of a sump(s), a dedicated pump(s), an automated pump activation system that activates the pump(s) when a specific fluid level is reached in a sump(s), a totalizing flow meter to measure to measure the volume of leachate pumped from the system, and an automated alarm system that provides warning of pump failure. Alternatively, a gravity drain system may be utilized where practicable.
Impacted stormwater impoundments that store impacted stormwater for less than 30 days **or** Process water and impacted stormwater long-term impoundments located within an open pit surface drainage area **or** Non-impacted stormwater impoundments located outside the open pit surface drainage area over contaminated areas where the water has the potential to infiltrate and produce a leachate that may cause an exceedance of the applicable standards[34]	• **Liner system.** At a minimum, impoundments are constructed as an engineered liner system consisting of a compacted sub-base overlain by a synthetic liner. **Alternate design** would need to provide the same or greater level of containment as the liner system described below. • **Liner system subgrade and liner bedding.** The liner system is prepared and placed upon a stable subgrade. The top surface of the subgrade is smooth and free of sharp rocks or any other material that could penetrate the overlying liner bedding or synthetic liner. Liner bedding is placed atop the subgrade and consists of a minimum of six inches of sand or fine soil to allow for good contact between liner and liner bedding. The liner bedding surface is sufficiently dry during liner installation such that free or excess water will not hinder the welding of seams. The liner installer provides the entity with a sub-grade and liner bedding acceptance certificate prior to installing the liner indicating acceptance of the earthwork. • **Liner type.** Synthetic liners provide the same or greater level of containment, including permeability, as a 60 mil HDPE geomembrane liner system. The liner system's tensile strength, tear and puncture resistance and resistance to degradation by ultraviolet light are compatible with design loads, exposure and conditions. • **Wind protection.** Liner systems are designed and constructed with a weighting system to secure the liner and limit liner damage during periods of extreme wind events when the impoundment is empty.
LINER INSTALLATION	
All	• Installed with sufficient slack in the liner material to accommodate expansion and contraction due to temperature changes. • No folds in the completed liner except to the extent necessary to provide slack. • Anchored in an anchor trench. The trench is of a size and setback distance sufficient for the size of the impoundment. • Liner panels are oriented such that all sidewall seams are vertical

[34] "Non-impacted stormwater" means stormwater run-off generated as a result of direct precipitation that does not exceed IRMA water quality standards.

	• Any opening in the liner through which a pipe or other fixture protrudes is sealed in accordance with the liner manufacturer's requirements. Liner penetrations are detailed in the construction plans and as-built drawings. • Installed by an individual that has the necessary training and experience as required by the liner manufacturer. • Manufacturer's installation and field seaming guidelines are followed. • Liner seams are field tested by the installer and verification of the adequacy of the seams shall be provided along with the as-built drawings. • If concrete slabs are installed on top of a liner for operational purposes, slabs are completed in accordance with manufacturer and installer recommendations to ensure liner integrity.
IMPOUNDMENT SPILLWAYS AND DIKES	
Spillways	• Impoundments have spillways to safely discharge the peak runoff of a 25-year, 24-hour precipitation event, or an event with a 90-percent chance of not being exceeded for the design life of the impoundment. • Impoundments intended as primary containment for process water cannot have a spillway that empties onto the ground surface.
Dikes	• Allow for access for maintenance unless justification can be provided otherwise.

2. TAILINGS IMPOUNDMENTS[35]

MATERIAL CHARACTERIZATION	
	• See Chapter 4.1.
ENGINEERING DESIGN[36]	
Design plans	• Design plans are signed and sealed by a licensed professional engineer.
Stormwater run-on	• Is diverted and/or contained to minimize contact between stormwater run-on and the tailing material. o The design considers the amount, intensity, duration and frequency of precipitation; watershed characteristics including the area, topography, geomorphology, soils and vegetation of the watershed; and run-off characteristics of the watershed including the peak rate, volumes and time distribution of run-off events.
Seepage from the sides of a tailing impoundment	• The design of tailing seepage collection systems is based on consideration of site-specific conditions. • Seepage is captured and contained through the construction of headwalls, impoundments and diversion structures as applicable.
Groundwater impacted by the tailing impoundment	• An aquifer evaluation is undertaken to determine the potential nature and extent of impacts on groundwater from the tailings impoundment based on the proposed tailings impoundment design. The aquifer evaluation includes a complete description of aquifer characteristics and hydrogeologic controls on movement of tailing drainage and ground water impacted by the tailings impoundment. • If groundwater is predicted to be or is in excess of applicable standards it is captured and contained through the construction of interceptor systems designed to maximize capture of impacted ground water and minimize the extent of ground water impacted by the tailings impoundment. • A design report for a proposed interceptor system for containment and capture of ground water impacted by the tailings impoundment includes, at a minimum: o construction drawings and interceptor system performance information,

[35] IRMA is proposing that this table also applies to dry stack tailings.
[36] If a critical facility, design criteria in proposed Chapter 4.X also apply (see 4.X.3. Initial Assessment, Siting and Design of Critical Facilities).

	- recommended equipment including pumps and meters, recommended pump settings and pumping rates, - methods for data collection, and a demonstration that the entity has adequate water rights to operate the system as designed, - demonstration that interceptor system design will capture ground water impacted by the tailings impoundment such that applicable standards will not be exceeded at specified monitoring well locations. • If it is determined that the proposed tailings impoundment, seepage collection and interceptor systems when constructed and operated in accordance with the design plan would cause groundwater to exceed applicable standards at specified monitoring well locations, the entity applies additional controls, which may include but are not limited to, a liner system.
OPERATIONAL REQUIREMENTS	
	• The tailings impoundment remains within the area identified in the design. • The perimeter of the tailings impoundment and any associated solution collection systems are inspected monthly. • Any evidence of instability in the tailings impoundment that could potentially result in a dam failure and an unauthorized release is reported to the regulatory authorities as soon as possible, but no later than 24 hours after discovery. • Any leaks or spills outside the tailings impoundment and any associated containment are recorded, reported to authorities (if required), and corrective action measures are taken in accordance with IRMA Chapter 4.1. (4.1.7) and Chapter 4.2 (4.2.4) as relevant. • If seeps occur, they are monitored on a monthly basis and an estimate of the seep flow rate is made. Monthly records of the seep inspections and flow rates are maintained and included in the site monitoring reports. • The average daily rate monthly volume of tailings placed in the impoundment is recorded, maintained, and included in the site monitoring reports. • Tailings deposition rates do exceed the maximum rates in the design criteria. • The daily tailings deposition and associated solution system collection rate is determined using flow meters. • The placement of tailings and effluent are done in accordance with an operating plan that describes the following: - the sequencing of tailings deposition on an annual basis; - measures to manage the surface impoundment area to maintain adequate freeboard; - operation of seepage collection systems; - operation of interceptor systems; - operation of systems to return water to the concentrator or other locations as appropriate; and - any other water management features.

3. OPEN PITS

MATERIAL CHARACTERIZATION	
	• See Chapter 4.1.
OPERATIONAL REQUIREMENTS	
Stormwater	• Stormwater is diverted outward and away from the perimeter of the open pit and, to the extent practicable, is not directed into the open pit.
Minimization of surface drainage area	• Facilities in and surrounding an open pit surface drainage area are designed and located to minimize the size of the open pit surface drainage area to the extent practicable.
Water Quality	• During operation of an open pit, the IRMA Water Quality Criteria do not apply within the area of open pit hydrologic containment.

4. UNDERGROUND MINES

MATERIAL CHARACTERIZATION	
	• See Chapter 4.1.
OPERATIONAL REQUIREMENTS	
Waste disposal	• Waste rock or tailings that may generate a leachate that may cause an exceedance of IRMA Water Quality Criteria are not disposed of underground • Deposition of any other wastes in an underground mine is only done if authorized by a regulatory authority. Records are kept of monthly volume of waste rock, tailings or waste placed in the mine.

5. WASTE ROCK STOCKPILES

MATERIAL CHARACTERIZATION	
	• See Chapter 4.1.
WASTE ROCK ENGINEERING DESIGN[37]	
Stormwater run-on	• Is diverted or contained to minimize contact between stormwater run-on and stockpiled material. • The design considers the amount, intensity, duration and frequency of precipitation; watershed characteristics including the area, topography, geomorphology, soils and vegetation of the watershed; and run-off characteristics of the watershed including the peak rate, volumes and time distribution of run-off events.
Seepage from the sides of a waste rock stockpile	• Is captured and contained through the construction of headwalls, impoundments and diversion structures as applicable.
Groundwater impacted by waste rock stockpiles	• If in excess of applicable standards is captured and contained through the construction of interceptor systems as applicable.
OPERATIONAL REQUIREMENTS	
New waste rock stockpiles	• An operating plan that describes the sequencing of waste rock deposition on an annual basis, operation of seepage collection systems, operation of interceptor systems, operation of systems to return water to the concentrator or other locations as appropriate, and any other water management features. • The placement of waste rock is in accordance with an operating plan, and the stockpile remains within the area identified in the design plan. • The perimeter of the stockpile is inspected monthly. • Any evidence of mass instability in the stockpile that could potentially result in a slope failure that may result in an unauthorized release is reported to regulatory authorities (if required) as soon as possible, but not later than 24 hours after discovery and a corrective action plan is developed and implemented to restore structural integrity. • Any leaks or spills of leachate outside the waste rock stockpile and any associated containment system are recorded, reported to authorities (if required), and corrective action measures are taken in accordance with IRMA Chapter 4.1. (4.1.7) and Chapter 4.2 (4.2.4) as relevant. • If seeps occur, they are monitored on a monthly basis and an estimate of the seep flow rate is made. Monthly records of the seep inspections and flow rates shall be maintained and included in the site monitoring reports. • If an interceptor system to maintain capture of ground water impacted by a waste rock stockpile exists, the entity monitors interceptor system collection using flow meters.

[37] The requirements are applicable for new engineered structures for waste rock stockpiles unless the entity can demonstrate that an alternative design will provide an equal or greater level of containment. An existing waste rock stockpile is not required to meet the design requirements unless groundwater monitoring of the stockpile pursuant to IRMA Chapter 4.2 indicates a need for corrective action.

6. CRUSHING, MILLING, CONCENTRATOR, SMELTING AND REFINING FACILITIES

ENGINEERING DESIGN[38]	
New crushing and milling units	• New crushing and milling units, including associated ore storage, except when located within the open pit surface drainage area, are designed to contain and manage all materials containing water contaminants that have the potential to migrate to ground water and cause an exceedance of applicable standards on concrete or low permeability surfaces.
New concentrator units.	• New concentrator units are designed to contain and manage in tank and pipeline systems all materials containing water contaminants that have the potential to migrate to ground water and cause an exceedance of applicable standards. • Tailing and concentrate thickener tanks may be constructed with concrete or low permeability bottoms consisting of a minimum of 12 inches of soil that has a minimum re-compacted in-place coefficient of permeability of $1x10^{-6}$ cm/sec. o The tank designs shall be based on plans and specifications signed and sealed by a licensed professional engineer. o For low permeability bottoms, such plans and specifications shall describe how process rates, material density and settling rates were considered in the design to minimize infiltration such that water contaminants in the tank will not migrate to ground water and cause an exceedance of applicable standards.
New smelting and refining units.	• New smelting and refining units are designed to contain and manage on impermeable surfaces all materials, including associated slag and flue dust, containing water contaminants that have the potential to migrate to ground water and cause an exceedance of applicable standards.
OPERATIONAL REQUIREMENTS	
Crushing, milling and concentrating	• Operations remain within the area identified in an operating plan. • All containment system structures are inspected monthly. • Any leaks or spills of process water outside the containment system are recorded, reported to authorities (if required), and corrective action measures are taken in accordance with IRMA Chapter 4.1. (4.1.7) and Chapter 4.2 (4.2.4) as relevant.
Smelting and refining units	• Operations remain within the area identified in an operating plan. • Slag, flue dust and any other waste products generated as a result of smelting or refining activities are characterized, managed, and properly stored and disposed in a manner consistent with IRMA 4.1. • Any leaks or spills outside the containment systems of the smelter unit are recorded, reported to authorities (if required), and corrective action measures are taken in accordance with IRMA Chapter 4.1. (4.1.7) and Chapter 4.2 (4.2.4) as relevant.

7. LEACH PILES

ENGINEERING DESIGN[39]	
New leach stockpiles	• **Liner system.** Leach piles are placed on an engineered liner system consisting of a subgrade and compacted earthen liner overlain by a synthetic liner which is overlain by a solution collection system designed to transmit process fluids out of the leach pile. The liner system is installed in accordance with a CQA/CQC plan. • **Liner system subgrade and earthen liner.** A liner system earthen liner is prepared and placed upon a stable subgrade. The prepared earthen liner consists of a minimum of 12 inches of soil that has a minimum re-compacted in-place coefficient of permeability of $1x10^{-6}$ cm/sec. The top surface of the earthen liner is smooth and free of sharp rocks or any other material that could penetrate the overlying synthetic liner. • **Liner type.** A synthetic liner for a leach stockpile provides the same or greater level of

[38] The requirements are applicable in designing crushing, milling, concentrating, smelting and refining facilities unless the entity can demonstrate that an alternative design will provide an equal or greater level of containment.

[39] The requirements are applicable in designing leach pile (e.g., heap leach and acid leach piles) facilities unless the entity can demonstrate that an alternate design will provide an equal or greater level of containment.

	containment, including permeability, as a 60 mil HDPE geomembrane liner system. The liner system's tensile strength, tear and puncture resistance and resistance to degradation by ultraviolet light is compatible with design loads, exposures and conditions. A licensed professional engineer with experience in liner system construction and installation shall identify the basis for the geomembrane composition and specific liner based upon: o the type, slope and stability of the subgrade; o the overliner protection and provisions for hydraulic relief within the liner system; o the load and the means of applying the load on the liner system; o the compatibility of the liner material with process solutions applied to the leach stockpile and temperature extremes of the location at which it will be installed; and o the liner's ability to remain functional for five years after the implementation of closure of the leach stockpile. • **Solution collection system.** A solution collection system is constructed in an overliner protection and drainage system. The solution collection system is designed to remain functional for five years after the operational life of the leach pile. The overliner protection is designed and constructed to protect the synthetic liner from damage during loading and minimize the potential for penetration of the synthetic liner. A sloped collection system is designed to transmit fluids out of the drainage layer of the leach pile. The collection system is designed to maintain a hydraulic head of less than the thickness of the drainage layer but the drainage layer shall not exceed five feet in thickness. Any penetration of the liner by the collection system through which a pipe or other fixture protrudes is constructed in accordance with the liner manufacturer's requirements. Liner penetrations are detailed in the construction plans and as-built drawings. • **Solution containment systems.** Pregnant leach solution (PLS) flows exiting the leach pile are collected, contained and conveyed to a process water impoundment(s) or tank(s) using pipelines or lined conveyance systems. • **Alternative design.** An entity may propose an alternative design for a leach pile located within an open pit surface drainage area provided that the stockpile and solution capture systems are designed to maximize leach solution capture considering the site-specific conditions of the open pit, underlying geology and hydrology, and leach solutions will not migrate outside of the open pit surface drainage area.
OPERATIONAL REQUIREMENTS	
	• A pile remains within the area identified in the operating plan and applicable discharge permits. • The perimeter of the pile and the solution collection system are inspected monthly. • Any evidence of instability in the stockpile that could potentially result in a slope failure or an unauthorized release is reported to an accountable executive as soon as possible, but not later than 24 hours after discovery, and corrective action plans are developed and implemented. • Any leaks or spills of PLS or leach solutions outside the leach pile or containment system are recorded, reported to authorities (if required), and corrective action measures are taken in accordance with IRMA Chapter 4.1. (4.1.7) and Chapter 4.2 (4.2.4) as relevant. • If seeps occur, they are monitored on a monthly basis and an estimate of the seep flow rate is made. Monthly records of the seep inspections and flow rates are maintained and included in the site monitoring reports. • Leach solution application rates do not exceed the maximum rates in the plan of operations. • The daily leach solution application and PLS collection rate is determined using flow meters. The daily rate and monthly volume of leach solution applied and PLS collected are recorded, maintained, and included in the site monitoring reports.

8. CHEMICAL LEACHING AND PROCESSING FACILITIES

ENGINEERING DESIGN[40]	
Chemical leaching and processing facilities	• All chemical leaching and processing facilities are designed to contain all associated process fluids within impermeable vessels with secondary containment or process water impoundments meeting the requirements of this section. • All pipeline and tank systems associated with chemical leaching and processing facilities are designed in accordance with 8. New Pipelines and Tanks.
OPERATIONAL REQUIREMENTS	
	• All solution management and extraction operations are contained within pipeline and tank systems designed and operated pursuant to Section 9. New Pipelines and Tanks or process water impoundments meeting the requirements in Section 1. Impoundments (see process water impoundments). • Sludge, spent electrolyte or other waste products from the chemical leaching or processing are disposed in a manner consistent with IRMA 4.1.

9. PIPELINES AND TANKS

ENGINEERING DESIGN[41]	
New Pipelines	• Are constructed of impermeable materials that are compatible with the particular contents that are contained and carried in the pipeline and are resistant to degradation by ultraviolet light if they will be exposed to sunlight. • For pipelines located outside of the open pit surface drainage area and outside an area authorized for discharge of process water, impacted stormwater or tailings, the entity: o incorporates a mechanism for monitoring the integrity of the pipeline system including visual inspections, pressure change sensors, or other appropriate means; and o incorporate a mechanism of secondary containment to contain and control leaks and spills including berms, placement within or drainage toward areas authorized for discharge of the conveyed fluids, and impoundments that are constructed consistent with the requirements of this section.
New Tanks	• Tanks are designed and constructed of steel, concrete or impermeable materials that are compatible with the particular contents that are contained within the tank and resistant to degradation by ultraviolet light where exposed to sunlight. • Tank systems have a constructed foundation consisting of a stable, level base free of rocks, debris, sharp edges or irregularities that could puncture, crack or indent the tank materials. • Tank systems are designed to prevent overflow and the collection of surface water run-on. • Above-ground tank systems are bermed to contain 110 percent of the volume of the largest tank within the system or the largest interconnected tanks. • Below-grade tank systems are either be placed in such a manner that the side walls are open for visual inspection or the tank shall be designed with a secondary containment and leak detection system.
Existing pipeline or tank systems	• A pipeline or tank system already in existence is not required to meet the design requirements of this section provided that the operational requirements below are met. • If an existing tank or pipeline system cannot maintain integrity it is replaced in accordance with the engineering requirements for new tanks and pipelines in this section.
OPERATIONAL REQUIREMENTS	
	• Pipelines and tanks remain within the area identified in the operations plan. • Pipelines, tanks and secondary containment systems are inspected on a monthly basis.

[40] The requirements are applicable in designing chemical leaching and processing facilities (unless the entity can demonstrate that an alternate design will provide an equal or greater level of containment).

[41] The requirements are applicable in designing new pipeline and tanks systems (unless the entity can demonstrate that an alternate design will provide an equal or greater level of containment).

	• Below-grade tank(s) are maintained and operated to prevent overtopping of the tank(s). • Any leaks or spills of fluids, process water or tailings from a pipeline or tank system are recorded, reported to authorities (if required), and corrective action measures are taken in accordance with IRMA Chapter 4.1. (4.1.7) and Chapter 4.2 (4.2.4) as relevant. • Existing pipelines that do not meet the engineering requirements above shall be evaluated for integrity at least once every five years. • Existing below-grade tanks that do not meet the engineering requirements of this section shall be emptied and visually inspected for integrity at least once every five years. • Existing tanks in contact with the ground surface and located outside an open pit surface drainage area are inspected and tested at least once every ten years for integrity. • A written record of all pipeline and tank system inspections and integrity testing is maintained by the entity for a period of at least five years. • Any wastes generated from the cleaning of pipeline or tank systems are disposed of in a manner consistent with IRMA Chapter 4.1.

10. TRUCK AND EQUIPMENT WASHING UNITS

ENGINEERING DESIGN[42]	
New and Existing Truck and Equipment Washing Units	• Truck and equipment washing is conducted on a concrete pad or a pad constructed of materials of equivalent or lower permeability designed to capture all wash water. • Captured wash water freely drains from the containment pad and when necessary is conveyed to an oil water separator to remove oil and grease from the wash water. • Wash water from the oil water separator is conveyed to a tank system designed (and constructed section 8, above), an impoundment meeting the requirements of Section 1. Impoundments, or may be directed to the mine process water circuit for use.
OPERATIONAL REQUIREMENTS	
	• A truck or equipment wash unit remains within the area identified in the operations plan. • Wash water generated at the unit is contained within the designed containment pad, separator and tank system, or impoundment until treated to meet applicable standards for discharge or conveyed to the process water circuit. • Any leaks or spills of wash water from the containment pad, separator, tank system or impoundment are recorded, reported to authorities (if required), and corrective action measures are taken in accordance with IRMA Chapter 4.1. (4.1.7) and Chapter 4.2 (4.2.4) as relevant. • Any wastes generated from the oil water separator or the tank system shall be disposed in a manner consistent with IRMA 4.1.

[42] The requirements are applicable in designing truck and equipment washing units (unless the entity can demonstrate that an alternate design will provide an equal or greater level of containment.