IRMA

Initiative for Responsible Mining Assurance

# EXCERPT FROM THE

# IRMA Standard

for

Responsible Exploration, Extraction, and Processing of Minerals

⊰ 2nd DRAFT ⊱

**for public consultation**

CHAPTER 4.3 – **Water Management**

**IRMA Standard v2.0 DRAFT 2**

**July 2025**

English Version

# Disclaimer and Context on this Draft

The 2nd DRAFT Version of the IRMA Standard for Responsible Exploration, Extraction, and Processing of Minerals V2.0 (hereafter referred to as the “2nd DRAFT”) is being released for public consultation, inviting the world to join once again in a conversation around expectations that drive value for greater environmental and social responsibility in mining and mineral processing.

The 2nd DRAFT does not represent content that has yet been formally endorsed by IRMA’s equally-governed multi-stakeholder Board of Directors. IRMA’s Board leaders seek the wisdom and guidance of all readers to inform this through an inclusive revision process one more time, to improve the Standard.

This draft document builds on the 1st DRAFT Version published in October 2023, and invites a global conversation to improve and update the 2018 IRMA Standard for Responsible Mining V1.0. This 2nd DRAFT is intended to provide as final of a look-and-feel as possible, although input from this consultation will result in final edits, and consolidation to reduce overall number of requirements (more on this on page 6), for a version that will be presented to IRMA’s equally-governed multi-stakeholder Board of Directors for adoption and implementation.

This 2nd DRAFT has been prepared and updated by the IRMA Secretariat based on:

- learnings from the implementation of the current IRMA Standard (V1.0)
- experience from the first mines independently audited (as of July 2025, 24 sites have completed audits or are in the process of being audited)
- evolving expectations for best practices in mining to reduce harm
- comments and recommendations received from stakeholders and Indigenous rights-holders
- the input of subject-specific Expert Working Groups convened by IRMA between 2022 and 2024
- all comments and contributions received during the public-comment period of the 1st DRAFT version (October 2023-March 2024)

Please note that 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 exploration, extraction, and processing of minerals happens.

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.

This current 2nd DRAFT is based on content already in practice in the IRMA Standard for Responsible Mining V1.0 (2018) for mines in production, and its accompanying normative Guidance document and Supplementary Guidance, combined with the content drafted in the IRMA Standard for Responsible Mineral Development and Exploration (‘IRMA-Ready’ Standard – Draft v1.0 December 2021) and in the IRMA Standard for Responsible Minerals Processing (Draft v1.0 June 2021), and offers an updated version of the 1st DRAFT Version of the IRMA Standard V2.0 that received over 2,500 unique points of comments between 2023 and 2024.

**Please note: The IRMA Standard V2.0 is new in its approach in that it now covers more phases of the mining and mineral supply chain, from exploration and development, through mining, closure, and mineral processing.** IRMA also, separately, oversees a Chain of Custody Standard for tracking materials through the supply chain from mine-to-market end use products.

## Disclaimer on Language and Corrections

For this public consultation, only an English version is available. A Glossary of Terms used in this Standard is provided at the end of the full version of the document (see below). 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.

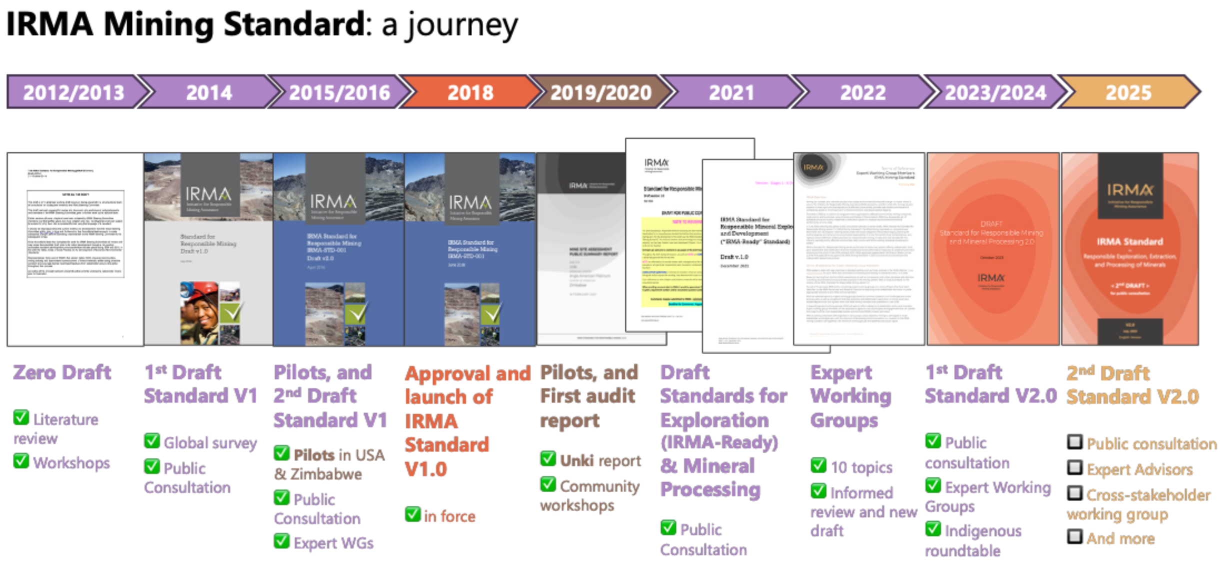
**This document provides only one chapter excerpt from the IRMA Standard v2.0 DRAFT 2.**

**The full version contains 27 Chapters, click here to view it.**

# Objectives of this 2nd public consultation

Following the release of a 1st DRAFT of the IRMA Standard V2.0 in October 2023 for a 90-day public consultation, the IRMA Secretariat received more than 2,500 points of comments from 82 organizations, then organized additional engagement with stakeholders and Indigenous rights-holders, and solicited complementary guidance from multiple topic-specific Expert Working Groups.

We anticipated release of this 2nd DRAFT for a second round of public consultation as early as Q3 2024, then subsequently announced that more time was needed to support engagement of diverse stakeholders; the revised release date was July 2025. We provided more detailed explanation for the extended process here and here.




The release of this 2nd DRAFT marks a significant milestone on the road to the revision of the IRMA Standard: this public consultation will be the last of this revision cycle on V2.0.

Informed by the outcomes of this public consultation, along with guidance from Expert Advisors and IRMA Working Groups (see more below), and additional engagement with Indigenous rights-holders and stakeholders as requested, the IRMA Secretariat will prepare a final version. This final version will be discussed by the IRMA Board and refined to reach consensus for adoption by all six governing houses of IRMA: Affected Communities including Indigenous Rightsholders; Environmental and Social NGOs; Organized Labor; Finance and Investment Professionals; Mining Companies; Purchasers of Mined Materials.

In IRMA's strategic decision-making, Board members work to achieve consensus. IRMA believes a majority vote is not a model of equal governance. Instead, any motion that results in both of the two representatives from the same governing house voting "no" must go back to the full group for further discussion. In other words, a proposed course of action cannot proceed if both representatives from one of our six governing houses are opposed. Board members will keep talking until a resolution that works for all groups is found. It is a model that has worked for IRMA for nearly two decades and is fundamental to IRMA's credibility, accountability and service to all six houses of governance.

## What is IRMA seeking guidance on?

Comments, feedback, and suggestions are welcome on any aspect of this 2nd DRAFT version (including intent and text of the requirements, endnotes, annexes, format and structure, design, readability, etc.).

IRMA is particularly interested in hearing the views of rights-holders and stakeholders on **the provisions in the Standard that are substantially new compared to the IRMA Standard for Responsible Mining V1.0.** These provisions (requirements or at a sub-requirement level) are highlighted in yellow throughout this Draft, to ensure they are easily identifiable.

We ask readers to assist us in weighing these potential new provisions, and also hold awareness that, prior to adoption of the final version, many of these will be consolidated and reduced in overall number.

Although these new requirements have each been drafted in response to lessons learned, the current state of best practices, emerging expectations, and/or in response to requests and suggestions made during the previous public consultation, collectively they represent substantive increased expectations for both implementing entities and audit firms. The IRMA Board of Directors seeks to ensure that the IRMA Standard, while recognized the world's most rigorous and comprehensive mining standard, continue to welcome and support uptake of newcomer companies engaging from the mineral supply chain around the world.

Thus, in this consultation, we seek guidance from all on **the new provisions that seem most urgent** to be integrated in the final version of the Standard V2.0, so that the revised Standard's expectations are paced at a realistic level to support engagement of mineral operations of a range of sizes, materials and global contexts.

It is important to note that all new requirements and sub-requirements, including those not retained in the final V2.0, will serve as the basis for the ongoing review process once the V2.0 is approved and released by our Board, and will provide fodder for future revisions, when it is decided that a V2.1 or V3.0 is needed.

# Chapter 4.3
# **Water Management**

### SECOND DRAFT (JULY 2025): SUMMARY OF CHANGES

- Updated some Section names for clarity and consistency throughout the Standard.
- Several requirements restructured to increase clarity and auditability.
- Added clarification about need to gather baseline/background water quality/quantity information for operations on Brownfields sites.
- Added two new water uses: protection of aquatic life and ecosystem health that are important for protected and conserved areas, biodiversity and the delivery of ecosystem services; and religious and cultural uses (see endnote for 4.3.2.2.a).
- Modified language related to biodiversity and ecosystems to better align with revised Chapter 4.4.
- Changed all references to mine/mining operation to mine/mineral processing operations, because the Standard now applied to mineral processing operations as well as more traditional mine sites.
- Added diversion as a potential part of the water balance and added a definition to the glossary.
- Removed specific requirements regarding mixing zones, as a consensus amongst IRMA Board members is that the use of mixing zones is not 'best practice' and therefore should not be included in the IRMA Standard. In an endnote to 4.3.6.1, it has been clarified that a mixing zone can only be proposed after demonstrating that all technically feasible options for avoiding the need for a mixing zone have been investigated and implemented (and if it is legally permissible).
- Added clear links between identified water uses and applicable IRMA Water Quality Criteria by End Use-Tables.
- Changed requirement to share water data with affected community from monthly to quarterly but clarified that the data will include all water data over time from points of compliance (see 4.3.9.2).
- Added one optional requirement to mirror adaptive risk and impact assessment for water quantity (4.3.3.5).
- New requirement added to close the Plan-Do-Check-Act loop to deliver continuous improvement (through regular updates and revised processes and criteria, informed by monitoring, evaluation, and review), this is now harmonized throughout the Standard.
- New critical requirement added to demonstrate water quality compliance, over at least the last twelve months (see Section 4.3.9 on Information-Sharing and Public Reporting)

- Officially added Annex 4.2-A on Water Monitoring and Reporting Guidance (now Annex 4.3-B), with plan to add non-US references. Former proposed Annex 4.2-B related to best practices was deemed more relevant to facilities (mine, mine waste, and mineral processing facilities) and has been removed. IRMA proposes to discuss the issue of verification of use of best water management/mitigation practices further within a working group.

- IRMA Water Quality Criteria by End-Use Tables (now Annex 4.3-A) – reviewed and updated.

## RESPONSE TO CONSULTATION QUESTIONS OUTLINED IN FIRST DRAFT

| Question # | Question | Feedback and Proposed Decision |
|---|---|---|
| 4.2-01<br>(4.2.3.4) | **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? | **Feedback** (4): 3 mining, 1 consultant. One respondent suggested to require 3rd-party review of models. The following programs were suggested by various respondents: MODFLOW, Leapfrog, MIKESHE and FEFLOW.<br><br>**Proposed decision**: We will add MODFLOW, Leapfrog, MIKESHE, and FEFLOW to guidance. We will also consider a workshop on how to increase confidence in model results; consider requiring an independent review of model, especially if programs are proprietary and little operational data exist. |
| 4.2-02<br>(4.2.4.1) | **(Annex: Best Practices to Manage Water Risks Associated with Various Facilities)**<br>**Question**: 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. | **Feedback** (6): 1 mining: Defer to local regulatory guidance or use Annex if doesn't exist; Annex generally good approach but not all reasonable (e.g., prefers design for 100-yr not 200-yr storm). 1 consultant + 1 mining: Agree to add annex. 1 mining: Agree but annex needs much work. 1 mining interested in joining a working group.<br>1 NGO is separately requesting independent review of models required in 4.3.3.2.<br><br>**Proposed decision**: Did not include Annex for now; IRMA proposes to discuss it further within a working group, as well as the need for independent review of models in certain circumstances. |
| 4.2-03<br>(4.2.4.3) | **Question**: 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. | **Feedback** (3): 1 mining: Water monitoring/mitigation plans more valuable than a risk assessment; can't know if long-term treatment will be needed w/o operational data. 1 mining: Future iterations may be needed, but current language is sufficient. 1 consultant: no suggestion.<br><br>**Proposed decision**: Maintain the current proposed approach to long-term water treatment in the draft Standard. |
| 4.2-04<br>(4.2.4.7, Critical) | Question: 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)? | **Feedback** (6): All (4 mining, 1 purchaser, 1 consultant) agree that management plans for other resources should contain adaptive management elements, but separate AMPs for each resource are not necessarily needed. Specific resources mentioned include biodiversity, air quality, GHGs, land and soil,<br><br>**Proposed decision**: Some elements of adaptive management integrated in 3.7 (Noise and Vibration), and 4.5 (Air Quality). The harmonization of monitoring and evaluation + continuous improvement sections across all chapters also reflects this |
| 4.2-05 | **Question**: We do not currently have any prescribed frequency for sampling. We are considering requiring that samples be | **Feedback** (8): 1 mining + 1 purchaser: at least quarterly. 1 consultant + 1 Indigenous organization: at least monthly. 1 NGO: monthly for water quality, quarterly for water |

| | | |
|---|---|---|
| (4.2.5.1, Critical) | collected and analyzed monthly unless there is a legitimate reason for a different sampling frequency, but would appreciate feedback on this topic. | levels/balance. 3 mining: IRMA should not prescribe frequency (one flagging the need to consider seasonal conditions)<br><br>**Proposed decision**: IRMA will not prescribe a particular frequency. We have added an endnote that specifies "The frequency of sampling will be dependent on the results of baseline/background water sampling, the presence of storms and extreme events, and releases of project-affected waters according to the adaptive management plan outlined in 4.3.6."<br><br>Note that based on stakeholder input, we also propose to require consideration of temporal variability in addition to seasonal variability in the gathering of baseline/background data in in 4.3.1.1. |
| 4.2-06<br><br>(4.2.5.1, Critical) | **Question**: 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? | **Feedback** (6): No respondents knew of international or national water quality standards for REEs. 1 NGO and 1 Indigenous organization suggest that IRMA shouldn't include REE mines until it develops criteria specific to these radioactive waste issues. (e.g., waste management, monitoring, monitoring for radionuclides, etc.). 1 purchaser suggests measure REEs as part of their characterization; 1 mining is in favor of characterizing if known health effects. 1 consultant suggests to use background values or establish criteria (IRMA or the ENTITY).<br><br>**Proposed decision**: Water quality standards for REE were investigated during the review of the IRMA Water Quality Criteria By End-Use tables (Annex 4.3-A). As mentioned in the Summary of the Chapter above, those tables were updated, but no values were added for REEs due to a dearth of relevant standards (only one reference to one REE was found – guideline value for Lanthanum in Australia and New Zealand's guidance). Some radioactive parameters were updated (e.g., Radium 226/228, Uranium).<br><br>Note that IRMA requires the geochemical characterization of ores in Chapter 4.1, so if there are radioactive elements such as uranium or thorium in REE ores that could be released as a result of mineral processing, they would need to be identified as per requirement 4.1.2.1, would be expected to be included in baseline sampling (in water and/or air), and if concentrations are high enough to pose a risk to human health or the environment they would need to be mitigated.<br><br>As more information on REEs becomes available, IRMA will revisit its approach. |
| 4.2-07<br><br>(4.2.7.2) | **Question**: 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. | **Feedback** (4): 1 mining flag difficulty to share water data because some communities don't have WiFi. 2 mining say that monthly is too cumbersome, request change to quarterly. 1 purchaser recommends to Use Alliance for Water Stewardship (annual disclosure). |

| | | |
|---|---|---|
| | | **Proposed decision**: IRMA is proposing that in 4.3.9.2 to make summaries of water data available quarterly, but all water data should be available, not individual months only. Requirement 4.3.9.2 also requires summaries of water data to be published and shared with stakeholders from affected communities whether they are requested or not.<br><br>Discussions related to water data could also be shared as per Section 4.3.8, which requires Entities to review water quality management strategies, monitoring results, and adaptive management issues with relevant stakeholders on an annual basis. |
| 4.2-08<br><br>(Water quality criteria by end use tables) | **Question**: 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. | **Feedback** (4): Four respondents expressed their interest in reviewing the updated water quality tables.<br><br>*Response to one respondent who enquired about contradiction between legal criteria and IRMA criteria*: Regarding the IRMA Water Quality Criteria Tables, if the jurisdiction's standards meet or exceed (i.e. are more protective than) IRMA's water quality values, those will take precedence. However, if IRMA's are more protective, they will take precedence (as a standard reflecting best practice, and not just legal compliance), depending of course on the identified water uses. And in some cases, the jurisdiction will have additional standards that IRMA does not; in this situation, the jurisdiction's standards will apply.<br><br>**Proposed decision**: Now that the IRMA Water Quality Criteria tables have been updated, IRMA will reach out directly to those stakeholders who expressed interest in reviewing the tables, and will also announce more generally that the tables are ready for review by others who might be interested. |
| 4.2-09<br><br>(Annex 4.2-A) | **Question**: 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? | **Feedback** (4): 1 NGO requests change baseline data collection to over a two-year period. 2 mining and 1 consultant: Annex 4.2-A (now Annex 4.3-B) is reasonable. 1 mining suggests that specifics in the annex should not be a requirement. 1 consultant suggests that more could be added on groundwater monitoring.<br><br>**Proposed decision**: Annex 4.3-B is guidance, and is not normative.<br><br>Annex 4.3-B has been revised such that baseline monitoring collection occurs over a two-year period.<br><br>Based on additional discussion with mining companies, non-US references and information will be added to the annex. |

## BACKGROUND

Project-related activities can affect water quality in many ways, including from: the discharge of treated mine or process effluents 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.

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 own impacts, but also their role in cumulative impacts on water, locally or regionally. They are also aware of their dependencies, and are participating in collective actions with diverse stakeholders to address shared water challenges and opportunities that lead to positive water management outcomes at 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.

### KEY REFERENCES

This chapter strongly builds on, or aligns with, the following international or multilateral frameworks, conventions, and guidance:

- United Nations Convention on the Law of the Non-navigational Uses of International Watercourses, 1997
- United Nations Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention), 1992
- United Nations Convention on the Law of the Sea, 1982
- Minamata Convention on Mercury, 2013
- The International Cyanide Management Code for the Manufacture, Transport and Use of Cyanide in the Production of Gold, (The Cyanide Code), 2002

## OBJECTIVES OF THIS CHAPTER

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

## SCOPE OF APPLICATION

This chapter is applicable to all exploration, mining and mineral processing projects and operations. For each requirement, the following colors are displayed in the margin to indicate the phases for which it is required:

| | |
|---|---|
| E1 | Exploration – Stage 1 |
| E2 | Exploration – Stage 2 |
| E3 | Exploration – Stage 3 |
| D | Project Development and Permitting |
| M | Operating Mine |
| P | Operating Mineral Processor |

## CRITICAL REQUIREMENTS IN THIS CHAPTER

Throughout the Standard, critical requirements are identified using a red frame.
There are two (2) **critical requirements** in this Chapter.

## OPTIONAL IRMA+ REQUIREMENTS IN THIS CHAPTER

Throughout the Standard, optional IRMA+ requirements are identified using a dotted blue frame. There is one (1) **optional IRMA+ requirement** in this Chapter.

In this second draft, IRMA introduces a new category of requirements: IRMA+. These requirements are aspirational and forward-looking. They reflect emerging expectations and recommendations from stakeholders, but currently go above and beyond existing and established best practice. IRMA+ requirements are entirely optional, and they will not affect the scores and achievement levels obtained by the entities choosing to be assessed against them.

# IRMA Requirements.

## 4.3.1 Baseline/Background Data

E3 D M P

**4.3.1.1** Pre-impact data on baseline or background water quality and quantity are gathered by competent professionals as follows:

a. Data are gathered in sufficient detail to reliably determine the sources of water contamination related to the site and its associated facilities, and the changes in water quantity or quality that are unrelated to the site and its associated facilities[2];

b. For new operations at brownfield sites, the existing background water quantity and quality data are also determined[3];

c. Data include seasonal and temporal variability in the physical and chemical conditions of surface waters, natural seeps/springs and groundwaters that could be affected by the site and its associated facilities, including baseline/background concentrations of the comprehensive suite of parameters in IRMA Water Quality Criteria by End-Use Tables (See Annex 4.3-A) including weak acid dissociable cyanide (if cyanide is used or proposed to be used at the site or its associated facilities)[4];

d. Data include seasonal and temporal variability in the physical and chemical conditions of surface waters, natural seeps/springs and groundwaters that could be affected by the site and its associated facilities, including field parameters[5], measured at the time of baseline/background sampling; and

e. Data include seasonal and temporal variability in flows, levels, and presence, of surface waters, natural seeps/springs and groundwaters[6] that could be affected by the site and its associated facilities.

## 4.3.2 Scoping

E3 D M P

**4.3.2.1** Building on 1.3.2 and 2.1.3, a scoping process (or equivalent) is undertaken by competent professionals to identify all water users, water rights-holders, community members, and other stakeholders that may potentially affect or be affected by the ENTITY's water use and water management practices.

E3 D M P

**4.3.2.2** Building on 1.3.2 and 2.1.3, a scoping process (or equivalent) is undertaken by competent professionals, in collaboration with those affected rights-holders and stakeholders, to identify:

a. How water resources that may be affected by the project/operation are currently being used by humans and how they may be used in the future[7];

b. Other receptors[8] potentially affected by the project/operation's impacts on water quality, quantity, or availability; and

c. Water-related concerns, challenges, and opportunities that exist at the local and regional levels.

E3 D M P

**4.3.2.3** A scoping process (or equivalent) is undertaken by competent professionals to identify the activities of the site and its associated facilities that may pose risks or have impacts **on water quality**. This process considers[9]:

a. Direct, indirect, and cumulative, risks and impacts on **water quality**, including sedimentation risks, resulting from planned discharges or unplanned releases of contaminants of potential concern (COPCs);

b. Facilities for storing or disposing of tailings or mine waste[10], and other types of waste[11], if any, including risks and impacts related to facility failures and releases of mine waste (see Chapter 4.2);

c. Any mining and/or mineral processing facilities[12] and activities[13]; and

d. If any, evaporation ponds, sedimentation ponds, industrial stormwater retention/detention ponds, pregnant and barren solution ponds, and brine ponds.

E3 D M P

**4.3.2.4** A scoping process (or equivalent) is undertaken by competent professionals to identify the activities of the site and its associated facilities that may pose risks or have impacts **on water quantity and availability**. This process considers[14]:

a. Direct, indirect, and cumulative, risks and impacts on **water quantity and availability**, including groundwater levels, surface water flows, natural seep/spring flows, or environmental flows ;

b. The use, diversion[15] and discharges of water from the site and its associated facilities;

c. If any, activities such as groundwater extraction or pumping that may affect water resources; and

d. If any, the presence of open pits, underground workings, other mine facilities, waste facilities, water and brine impoundments, water and brine reinjection facilities, and processing facilities that modify runoff, groundwater flow and infiltration of precipitation.

E3 D M P

**4.3.2.5** A conceptual site model is developed by competent professionals[16], as follows:

a. It is developed using a credible methodology, and the methodology is documented;

b. It is proactively shared with affected rights-holders and stakeholders, in accordance with Section 1.2.3[17].

c. It includes a detailed description and depiction of the physiography, geology (including structural geology such as faults), hydrology, hydrogeology, climatology, and geochemistry of the site and its associated facilities as a whole[18];

d. It describes all potential sources of contamination related to the site and its associated facilities (identified in 4.3.2.3), and all contaminants of potential concern (see Chapter 4.1);[19] and

e. It describes what is known about site-wide contaminant release, transport, pathways between sources and receptors, and fate of contaminants along pathways and in receptors for the site and its associated facilities as a whole[20].

## 4.3.3 Risk and Impact Assessment

E3 D M P

**4.3.3.1** **Critical Requirement**

Building on 4.3.2, where potential sources of direct, indirect, and cumulative risks or impacts on **water quality** and/or **water quantity** are identified, a risk and impact assessment is carried out and documented by competent professionals, in collaboration with affected rights-holders and stakeholders, to identify and assess, for each identified risk and impact[21]:

a. The level of risk posed to, and the magnitude of impact on, human health and safety, and the environment;

b. The level of risk posed to, and the magnitude of impact on, current and future uses of water; and

c. This risk and impact assessment uses a credible methodology, and the methodology used is documented.

E3 D M P

**4.3.3.2** This risk and impact assessment is informed by the use of the following conceptual and numeric models:

a. A conceptual site model (required in 4.3.2.5), and conceptual models for facilities[22];

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 4.3.2.3 and 4.3.2.4) that: 1) 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; 2) 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; 3) Clearly identifies model assumptions, inputs, and uncertainty; and 4) Estimates the effects of water management on groundwater levels and stream/spring flows;

c. Hydrogeochemical and hydrogeological models, to predict or quantify potential impacts to water resources during all phases of the operation's life cycle (from construction through post-closure)[23]. These models: 1) Clearly identify model assumptions, inputs, and uncertainty; 2) Predict changes in stream flows and groundwater levels at points of compliance; and 3) Estimate concentrations of COPCs at points of compliance; and

d. These models are developed by competent professionals using credible methodologies, and the and the methodologies used are documented.

E3 D M P

**4.3.3.3** If, at any time during project development or operations, the concentrations of contaminants in water resource receptors are predicted to exceed baseline/background water quality or IRMA water quality criteria by end-use:

a. The risk and impact assessment is carried out as per 4.3.3.1 to evaluate whether source control or other effective mitigation measures will be required to mitigate impacts on water quality during operations and/or closure and post-closure[24];

b. This evaluation uses a credible methodology, and the methodology used is documented.

E3 D M P

**4.3.3.4** If, at any time during project development or operations, the potential exists for long-term[25] acid rock drainage or contaminant or metal leaching (see Chapter 4.1)[26], the risk and impact assessment is carried out as per 4.3.3.1 to:

a. Estimate the needed timing, volume, and duration of long-term water treatment, using the results from the water balance and water quality models;

b. Evaluate the potential consequences to human health and livelihoods[27] from a failure in long-term water treatment facilities;

c. Evaluate the potential consequences to protected and conserved areas, biodiversity and ecosystem services[28] from a failure in long-term water treatment facilities; and

d. These evaluations use credible methodologies, and the methodologies used are documented.

E3 D M P

**4.3.3.5** **IRMA+**

If, at any time during project development or operations, the availability of water is predicted to fall behind baseline/background water quantity or any minimum acceptable level defined in collaboration with affected users and stakeholders[29], the risk and impact assessment is carried out as per 4.3.3.1 to evaluate whether other effective mitigation measures[30] will be required to mitigate impacts on water quantity during operations and/or closure and post-closure.

## 4.3.4 Long-Term Water Treatment

E3 D M P

**4.3.4.1** If the need for long-term water treatment is predicted (as per 4.3.3.4) for any project or activity proposed to become operational after June 2018, the ENTITY ceases to pursue the proposed project or activity, unless **all** the following conditions are fully met:

a. The methodology, assumptions, and findings of the risk and impact assessment have been discussed with affected rights-holders and stakeholders, sufficiently in advance of decision-making, in accordance with Chapter 1.2;

b. The methods and indicators for gauging community support developed and monitored in accordance with Chapter 2.4 have demonstrated a high and diverse level of support to the proposed project or activity amongst affected rights-holders and stakeholders; and

c. If Indigenous Peoples whose rights or interests have been or may be directly or indirectly affected by any of the proposed or existing project or activity have been identified (as per 1.2.1.1. and 1.3.2.3), the ENTITY has obtained their Free, Prior, and Informed Consent for the proposed project or activity (as per Chapter 2.2).

E3 D M P

**4.3.4.2** For any project or activity proposed to become operational after June 2018 where the need for long-term water treatment is predicted and all the conditions in 4.3.4.1 have been fully met, or for activity that became operational before June 2018 where long-term water treatment has been identified or is predicted, and if the ENTITY decides to pursue the project/activity:

a. An action plan (or equivalent) including all the practicable steps that can, and will be, taken to minimize the volume of water to be treated is developed and implemented by competent professionals;

b. The ENTITY maintains estimates of human resources and budget required, and has a financing plan in place, to ensure that funding is available for the effective implementation of this action plan, including to construct, operate and maintain an effective water treatment plant[31]; and

c. The ENTITY ensures these estimated costs are calculated and included in the detailed determination of the estimated costs of reclamation and closure, and post-closure measures and activities in accordance with Section 2.7.2[32].

## 4.3.5 Water Monitoring Program

E3 D M P

**4.3.5.1** A water monitoring program is developed and implemented by competent professionals to monitor effects on water **quality and quantity**. The monitoring program includes a **sampling** plan (or equivalent) that:

a. Is consistent with practices listed in Annex 4.3-B[33];

b. Includes sample collection, handling and transportation protocols, sample hold times, analysis, quality assurance/quality control methods[34], and reporting requirements;

c. Includes sufficient monitoring locations at sites unaffected by the project (baseline locations) and at sites potentially affected by the project (points of compliance) to provide reliable data on changes to water quantity and quality conditions[35]; and

d. Collection of water quality and quantity samples **on a frequent enough basis**[36] to account for seasonal and temporal fluctuations, storm events, extreme events, and operational upset conditions that may cause changes in water quality or quantity[37].

E3 D M P

**4.3.5.2** The monitoring program includes an **analysis** plan (or equivalent) that:

a. Is consistent with practices listed in Annex 4.3-B;

b. Includes analysis, at the same frequency as in 4.3.5.1.d, of water quality samples for field parameters and all COPCs[38], including, if applicable, cyanide and mercury[39]; and

c. Analysis, at the same frequency as in 4.3.5.1.d, 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 (see Annex 4.3-A).

E3 D M P

**4.3.5.3** Besides any regular sampling and analysis required in 4.3.5.1 and 4.3.5.2, comprehensive sampling and analysis of the full suite of parameters in relevant IRMA Water Quality Criteria by End-Use Tables (see Annex 4.3-A) at points of compliance is conducted every five years, at a time of year when concentrations are expected to be the highest, to determine if unanticipated contaminants may be present[40].

E3 D M P

**4.3.5.4** If relevant, the monitoring program includes sampling of the water quality of, and documentation of the quantity of, mine-influenced waters destined for use by external third-party entities.

## 4.3.6 Adaptive Management Plan

E3 D M P

**4.3.6.1** Building on 4.3.3, and informed by the tools required in 4.3.3.2, an adaptive management plan for water (or equivalent) is developed and documented by competent professionals, to prevent, mitigate, and remediate all the risks impacts on water quality, and on water quantity and availability, identified as per Section 4.3.3. The plan includes mitigation measures that:

a. Regarding water **quality**, strictly align with the mitigation hierarchy, to prioritize source control and other measures that prevent or avoid the use or generation of contaminants, and/or measures that prevent of avoid the release of contaminants, including increased sediment load, relative to baseline conditions risk[41]; and

b. Regarding water **quantity and availability**, strictly align with the mitigation hierarchy, to prioritize measures that avoid the use, diversion or extraction of fresh water, and/or measures that avoid activities that adversely affect water resources and the protected and conserved areas, biodiversity and ecosystem services that they support[42].

E3 D M P

**4.3.6.2** The adaptive management plan:

a. Identifies potential water quality/quantity effects that could occur at monitoring locations, based on the risk and impact assessment (see 4.3.3);

b. Identifies key water quality and 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) measures to be taken to confirm the exceedance of IRMA Water Quality Criteria (see 4.3.5.2) or of a legal or other threshold, or if a trigger level is reached, together with estimated timelines for completion of these measures[43];

e. Assigns implementation of measures to responsible staff with adequate skills and expertise;

f. Assigns responsibility to its top management level to oversee plan implementation, monitoring, and recordkeeping[44];

g. Has an implementation schedule in place, and specifies annual, or more frequent, reviews of the effectiveness of the measures implemented;

h. Maintains estimates of human resources and budget required; and

i. Includes a financing plan in place, to ensure that funding is available for the effective implementation of the plan.

E3 D M P

**4.3.6.3** The adaptive management plan includes the creation of an action plan if exceedance of IRMA Water Quality Criteria or of other applicable thresholds is confirmed as per 4.3.6.2.d, as follows:

a. Determination of the areal extent of the impacts, and investigation of the cause/source of the exceedance;

b. Evaluation and selection of adaptive management measures developed as per 4.3.6.1, and/or development of additional or different measures that are likely to correct the exceedance[45];

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

d. Implementation of those corrective measures.

E3 D M P

**4.3.6.4** This adaptive management plan is developed collaboratively with affected rights-holders and stakeholders, as follows:

a. Options to address shared challenges and contribute positively to local and regional water stewardship outcomes are developed through collaboration with relevant affected rights-holders and stakeholders and are included in an action plan (or equivalent);

b. The affected rights-holders and stakeholders who participate have opportunities to review and provide feedback on draft prevention and mitigation measures, priority setting, and on draft qualitative and quantitative performance criteria, indicators, and trigger levels, that are relevant to them;

c. Draft and final versions of relevant documents and information are proactively shared with affected rights-holders and stakeholders in a meaningful, accessible, and culturally appropriate way (as per Section 1.2.3), clearly showing how their feedback and input was taken into account;

d. Effective procedures for rapidly[46] 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 affected rights-holders and stakeholders, in accordance with Chapter 2.6 (for rights-holders, local communities, and other stakeholders) and Chapter 3.2 (for workers); and

e. Engagement activities are carried out in a manner that is inclusive of different genders, ages, ethnicities, and any potentially underserved and/or marginalized people;

## 4.3.7 Monitoring and Evaluation

E3 D M P

**4.3.7.1** To monitor and evaluate the effectiveness and appropriateness of its measures to prevent, mitigate, and remediate risks and impacts to water quality, and to water quantity and availability, at least annually, and building on the water monitoring program required in Section 4.3.5, the ENTITY:

a. Tracks and documents its performance on water management, over successive time periods, against the key indicators and trigger levels defined in 4.3.6.2 and informed by stakeholder engagement as per 4.3.6.4;

b. If applicable, tracks and documents the effectiveness of the measures implemented to correct all confirmed exceedance of any IRMA Water Quality Criteria or other applicable thresholds, as per 4.3.6.3; and

c. Tracks and documents the effectiveness of the measures implemented to address shared challenges and contribute positively to local and regional water stewardship outcomes, as per 4.3.6.4.

E3 D M P

**4.3.7.2** The monitoring and evaluation process:

a. Encourages and facilitates joint monitoring and joint tracking with affected communities, in a manner that is inclusive of different genders, ages, ethnicities, and any potentially underserved and/or marginalized people, as per Chapter 1.2[47];

b. Includes continuous feedback from internal and external sources, including from joint monitoring and joint tracking with affected communities; and

c. If members of affected communities agree to participate in the water monitoring program required in Section 4.3.5, the ENTITY offers to cover, in full or in part, costs related to participation in monitoring and review of the monitoring program, including for independent experts, and a mutually-acceptable agreement for covering costs is developed.

## 4.3.8 Continuous Improvement

E3 D M P

**4.3.8.1** At least annually, but without undue delay after a significant change, the ENTITY collaborates with affected rights-holders and stakeholders to review the water monitoring program, and the ENTITY's ability to demonstrate[48] that:

a. Water quality parameters/contaminants measured at points of compliance are in compliance with relevant regulatory and permit requirements in the jurisdiction;

b. Water quality parameters/contaminants measured at points of compliance are either: 1) Being maintained at baseline or background levels for relevant parameters, which in some cases could exceed IRMA Water Quality Criteria; or 2) Being maintained at levels that are protective of the identified uses of those waters as per the IRMA Water Quality Criteria by End Use (see Annex 4.3-A)[49]; or 3) Being maintained at levels or conditions compliant to country of operation's regulatory requirements that are more protective than IRMA Water Quality Criteria for identified uses, or that fill gaps where no IRMA Water Quality Criteria exist; and

c. 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, protected and conserved areas, biodiversity and the ecosystem services that they support,[50] unless affected rights-holders and stakeholders have agreed that some decline in flows or water levels is acceptable[51].

E3 D M P

**4.3.8.2** At least annually, but without undue delay after a significant change, the ENTITY collaborates with affected rights-holders and stakeholders to:

a. Review all conceptual and numeric models required in 4.3.3.2, using operational monitoring data;

b. Review the water risk and impact assessment required in 4.3.3; and

c. Review the results of the monitoring and evaluation required in 4.3.7, and the effectiveness of the mitigation measures and adaptive management measures the ENTITY implements.

d. Develop and implement time-bound corrective measures to update, if necessary[52], its water risk and impact assessment, including the conception and numerical models, in accordance with Section 4.3.3;

e. Develop and implement time-bound corrective measures to update, if necessary[53], its water monitoring program, in accordance with Section 4.3.5; and

f. Develop and implement time-bound corrective measures to update, if necessary[54], its adaptive management plan to improve water management outcomes, in accordance with Section 4.3.6.

## 4.3.9 Information-Sharing and Public Reporting

E3 D M P

**4.3.9.1** The ENTITY makes and maintains publicly accessible[55]:

a. All the results of the baseline or background **water quality** evaluation for surface water, natural seep/springs, and groundwater; and

b. All the results of the baseline or background **water quantity** evaluation for surface water, natural seep/springs, and groundwater; and

E3 D M P

**4.3.9.2** At least quarterly, the ENTITY makes publicly accessible updated versions of, and maintains[56] publicly accessible all previous versions of:

a. A summary of all water data over time at points of compliance;

b. This summary, for **water quality**: 1) Presents 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[57]; and 2) Puts any deviations from criteria into context, taking into consideration likely stakeholder concerns regarding risks to human health and impacts on the environment;

c. This summary, for **water quantity**: 1) Presents 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; and 2) Puts 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; and

d. Is proactively shared with affected rights-holders and stakeholders in a meaningful, accessible, and culturally appropriate way, in accordance with Section 1.2.3.

E3 D M P

**4.3.9.3** **Critical Requirement**

The ENTITY:

a. Demonstrates publicly that it was able to maintain, for at least the last twelve months, all water quality parameters/contaminants measured at points of compliance: 1) in compliance with relevant regulatory and permit requirements in the jurisdiction; and 2) within one of the scenarios listed in 4.3.8.1.b;

b. If, and whenever, exceedance of IRMA Water Quality Criteria or of another threshold is confirmed (see 4.3.6.2), it creates a report summarizing the corrective measures required in 4.3.6.3, their outcome, and needed changes to improve the effectiveness of implemented mitigation measures identified in Section 4.3.6; and

c. If, and whenever, exceedance of IRMA Water Quality Criteria or of another threshold is confirmed (see 4.3.6.2), it makes and maintains this report publicly accessible, and proactively shares it with affected rights-holders and stakeholders in a timely, meaningful, accessible, and culturally appropriate way, in accordance with Section 1.2.3.

## CROSS REFERENCES TO OTHER CHAPTERS

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

## CHAPTER ENDNOTES

[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

[2] Sampling of baseline/background data will be expected to align with the monitoring guidance in Annex 4.3-B (unless entities have a clear and reasonable rationale for using alternative approaches). The frequency of sampling will be dependent on the results of baseline/background water sampling, the presence of storms and extreme events, and releases of project-affected waters according to the adaptive management plan outlined in 4.3.6. Note that a survey of the potential water bodies and groundwater resources that could be affected by the project/operation should have been carried out in the environmental and social impact assessment (Chapter 2.1, Section 2.1.4), but if not, then Entities would be expected to undertake a process to identify/survey and map of all water elements within the project's/operation's area of influence, so that their baseline characteristics can be established as per 4.3.1.1.

[3] Brownfield site background conditions will help determine changes in water quality/quantity caused by the new operation vs. the historic operation. Brownfield site background data collection will follow the same requirements in 4.3.1.1.a to d.

[4] 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

[5] I.e., pH, specific conductance, temperature, and potentially dissolved oxygen and turbidity (in surface waters) and redox potential (in groundwater).

[6] Including through an inventory of phreatophytes as indicators of groundwater dependence (field surveys or satellite based), where relevant.

[7] Water uses can include fishing and protection of aquatic life and ecosystem health that are important for protected and conserved areas, biodiversity and the delivery of ecosystem services (see requirement 4.4.1.1 and 4.4.1.3); drinking water; irrigation; livestock watering; aquaculture; recreation; industrial; and religious and cultural uses (see requirement 3.6.1).

[8] This includes plants and animals (including endangered and threatened species), habitats, and ecosystems.

[9] Note that information from Chapter 4.1 (Waste and Materials Management) will also be instrumental in identifying the risks to water quality. For example, the scoping process and characterization processes in 4.1.1 and 4.1.2 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 COPCs to the environment and affect water resources.

Also, information from Chapter 4.2 (TSF and Physical Stability Management) will help identify facilities that may be subject to failures and releases of materials that could affect the environment and water resources.

[10] Including tailings impoundments, waste rock dumps, slag heaps, heap and dump leach piles, open pits, pit lakes, underground workings.

[11] Including hazardous wastes, solid waste landfills, sewage treatment plants.

[12] Including mine pits and mine workings

[13] For mining, this includes for example blasting, transport of chemicals and materials. For mineral processing, this includes crushing/grinding, flotation, heap or vat leaching.

[14] Note that information from Chapter 4.1 (Waste and Materials Management) will also be instrumental in identifying the risks to water quality. For example, the scoping process and characterization processes in 4.1.1 and 4.1.2 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 COPCs to the environment and affect water resources.

Also, information from Chapter 4.2 (TSF and Physical Stability Management) will help identify facilities that may be subject to failures and releases of materials that could affect the environment and water resources.

[15] See new definition in glossary at the end of this chapter. Diversion could include, for example, water diverted for use in operations, or to generate hydroelectric power for the operation.

[16] A conceptual site model may have been developed in Chapter 2.1.

[17] Timeliness, comprehensiveness, usability, comparability, accessibility, and cultural appropriateness criteria for the sharing of information and data are identified, defined and reviewed in collaboration with stakeholders on a regular basis. Adequacy of the information sharing in this requirement therefore relies on Section 1.2.2.

[18] The description and depiction rely on information provided in requirements 4.3.1.1 (baseline), Chapter 4.1 (Waste and Materials Management) requirements in Section 4.1.2 (source material characterization), and Chapter 4.2 (TSF and Physical Stability Management), Section 4.2.1 (identification of tailings and wastes from mineral processing, underground and surface mines, which would then be characterized in 4.1.2).

[19] COPCs are identified in requirements 4.1.2.1, 4.1.2.2, and 4.1.2.4.

[20] 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.

[21] Requirement 2.1.3.3 in ESIA Scoping requires the identification and documentation of potential significant environmental and social impacts and risks that require further assessment. Also refer to 2.1.4.2.a, which requires: Consideration of whether the potential impacts are adverse or positive, direct or indirect, or if the project may contribute to cumulative impacts in its area of influence. If adequate documentation is not provided for 2.1.3, it needs to be done as required in 4.3.3.1.

[22] These facility models would be developed in a manner similar to that for the site model in 4.3.2.5, except for each facility.

[23] 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 4.1.2.1, 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 4.1.2.2 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 (See Annex 4.3-A), those constituents are identified as COPCs. The risk assessment will determine final contaminants of concern.

Also, as per requirement 4.1.1.1, 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.

[24] The risk and impact assessment must be informed by information on: 1) contaminants of potential concern; and 2) information on treatment methods and alternatives.

[25] I.e. potential risk of requiring water treatment after mine closure. See definition of 'long-term water treatment' in the Glossary.

[26] E.g., determined by the characterization of mined materials and waste in 4.1.2.1.

[27] The assessment should include consideration of direct, indirect and cumulative risks and impacts (e.g., ecosystem degradation, loss of threatened species, human health risk from consumption of fish containing high metal concentrations, livestock condition and mortality, crop productivity, etc.).

[28] The assessment should include consideration of direct, indirect and cumulative risks and impacts (e.g., ecosystem degradation, loss of threatened species, human health risk from consumption of fish containing high metal concentrations, livestock condition and mortality, crop productivity, etc.).

[29] See relevant consultation- and agreement-related requirements in Chapters 1.2, 1.3, 2.1, 2.2, 2.4, and 3.3.

[30] Mitigation measures include, but are not limited to, reduced operative rate or the use of alternative technologies/production methods.

[31] This information should feed into Chapter 2.7, requirements 2.7.1.6, 2.7.2.1, and 2.7.3.2.

[32] Including by basing them on the conservative assumption that they would be carried out by a regulatory agency using a third-party contractor.

[33] Biodiversity monitoring of aquatic biota is covered in Section 4.4.1.4 (baseline) and 4.4.7.1, if relevant.

[34] E.g., collecting replicate, trip blank, and equipment blank samples.

[35] See Chapter 2.1 – the monitoring network may have been established as part of the ESIA or equivalent.

[36] At least every quarter.

[37] The frequency of sampling will depend on the results of baseline/background water sampling in 4.3.1.1, the presence of storms and extreme events, and releases of project-affected waters according to the adaptive management plan outlined in 4.3.6.

[38] COPCs are determined in 4.3.2.3. Field parameters include pH, temperature, specific conductance, and potentially dissolved oxygen, redox potential and turbidity.

All parameters with a reasonable potential to adversely affect current and future water uses or receptors (see 4.3.2.2) must be sampled unless 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 (See Annex 4.3-A). If there is no reasonable potential for such an exceedance, then those parameters only need to be measured in samples every five years as per 4.3.5.2.c. The ENTITY can demonstrate that there is no reasonable potential, for example, if baseline or background monitoring do not detect the parameter, and source geochemical and chemical characterization (see Section 4.1.2 in Chapter 4.1), modeling, and other site-specific information indicate no/low probability that the parameter will be detected.

[39] Note that if cyanide is likely to be used at the site (see 4.1.7.1) then water samples at points of compliance 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.

If mercury is released to air or disposed on-site (see 4.1.8.1) 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 points of compliance 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.

[40] E.g., due to changes in ore, waste, or brine characteristics or processing methods as operations progress.

[41] 1) Priority must be 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; 2) Where elimination of contaminants through substitution or source control measures is not practicable or effective, mitigation measures are implemented to minimize the movement of contaminants to receptors where they can cause harm to human health, protected and conserved areas, biodiversity or the delivery of ecosystem services; 3) Then, if necessary, polluted waters are captured and treated to remove contaminants and improve water quality before water is returned to the environment or used for other purposes; and 4) As a last resort, 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 on human health, protected and conserved areas, biodiversity, the delivery of ecosystem services, or livelihoods.

IRMA Board members agree that the use of mixing zones is not best practice. Therefore, as per Step 1 above, Entities will be expected to demonstrate that all technically feasible measures have been investigated and implemented to avoid the use of mixing zones prior to their use.

[42] 1) Priority must be given to measures that avoid the use, diversion or extraction of fresh water, or to measures that avoid activities that adversely affect water resources and the protected and conserved areas, biodiversity and ecosystem services that they support; 2) If that is not possible, measures are developed, 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 protected and conserved areas, biodiversity and ecosystem services that they support; 3) Then, if necessary, measures to restore affected water supplies, protected and conserved areas, biodiversity and ecosystem services are developed; 4) As a last resort, if other options are not practicable or possible, water supplies are replaced with other sources in a manner that is agreed to by affected rights-holders and stakeholders (see also 4.3.6.4), and any impacts on protected and conserved areas, biodiversity or ecosystem services are managed as per Chapter 4..

[43] 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.

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

[45] Once a threshold exceedance is confirmed, different or additional actions may be needed than those in the adaptive management plan (in 4.3.6.2), because situations may not always unfold as expected, or more may need to be done than was originally anticipated. Often, actions 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.

[46] The timing of notification, information-sharing, and implementation of measures would depend on process developed and agreed on with affected rights-holders and stakeholders.

[47] This is especially relevant for contexts where your business and (potentially) affected rights-holders are in dispute about a particular (potential) adverse impact, and rights-holders are unlikely to accept the business' own tracking of the effectiveness of its response to it.

[48] Note that if this requirement is not met, then corrective measures would need to be developed as part of the adaptive management plan for water. See requirement 4.3.6.2.

[49] Identified uses correspond to the following IRMA Water Quality Criteria by End Use Tables, see Annex 4.3-A: fishing and protection of aquatic life and ecosystem health that are important for protected and conserved areas, biodiversity and the delivery of ecosystem services; drinking water; irrigation; livestock watering; aquaculture; recreation; and industrial. The protection of water quality for religious and cultural uses or preservation is variable, and the appropriate standards would depend on the activities (e.g., if ingestion occurs during a religious or cultural practice then standards for drinking water would apply; if dermal contact, then recreational standards might be more appropriate; if waters provide spiritual or cultural value in and of themselves, then there may be the need to consult with stakeholders or rights-holders to determine the appropriate water quality protections (see also Section 3.6.1).

[50] As identified in collaboration with relevant stakeholders (see 4.3.2.2).

[51] The acceptability of some reduction in flows would have been determined through consultations with affected stakeholders that happened in 4.3.2.2. If this requirement is not met, then corrective measures should be developed as part of the Adaptive Management Plan.

[52] This will be informed by the monitoring and evaluation process required in the previous Section, and on the review process required in a. to c.

[53] This will be informed by the monitoring and evaluation process required in the previous Section, and on the review process required in a. to c.

[54] This will be informed by the monitoring and evaluation process required in the previous Section, and on the review process required in a. to c.

[55] This is done in a meaningful, accessible, and culturally appropriate way, in accordance with Section 1.2.3.

[56] All material must remain publicly accessible *at least until the completion of all post-closure activities (including any previous versions, iterations and revisions). Note that the intention is not that the reports should be removed from the public domain after that. Rather, where possible, it should be retained indefinitely as the information may be important for legal or other purposes.*

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

## CHAPTER ANNEXES

## ANNEX 4.3-A: IRMA Water Quality Criteria by End-Use Tables

### 1) Criteria Protective of All IRMA Uses

| | | | Protective of All IRMA Uses | | |
|---|---|---|---|---|---|
| | | | FRESHWATER | | MARINE |
| | Units | | IRMA Surface Water[1] | IRMA Ground Water[2] | IRMA Marine Water |
| METALS / METALLOIDS | | | | | |
| Aluminum | ug/L | | 55 | 100 | 10 |
| Antimony | ug/L | | 6 | 6 | - |
| Arsenic | ug/L | | 10 | 10 | 8 |
| Barium | ug/L | | 300 | 300 | 700 |
| Beryllium | ug/L | | 4 | 4 | - |
| Boron | ug/L | | 500 | 500 | 750 |
| Cadmium | ug/L | | 1.8 * | 5 | 0.12 |
| Calcium | mg/L | | measure | - | - |
| Chromium (Total) | ug/L | | 50 | 50 | - |
| Chromium (III) | ug/L | | 4.9 | 4.9 | 27 |
| Chromium (VI) | ug/L | | 1 | 8 | 1.5 |
| Cobalt | ug/L | | 50 | 50 | 1 |
| Copper | ug/L | | 2.4 * | 200 | 1.3 |
| Iron | ug/L | | 300 | 300 | 2 |
| Lead | ug/L | | 2.5 * | 10 | 4.4 |
| Lithium | ug/L | | 2500 | 2500 | - |
| Magnesium | mg/L | | measure | - | - |
| Manganese | ug/L | | 50 | 50 | 10 |
| Mercury | ug/L | | 0.06 | 1 | 0.016 |
| Molybdenum | ug/L | | 10 | 10 | - |
| Nickel | ug/L | | 20 | 20 | 5 |
| Potassium | mg/L | | measure | - | - |
| Radium 226/228 | pCi/L | | 13.5 | 13.5 | - |
| Selenium | ug/L | | 1 | 20 | 10 |
| Silver | ug/L | | 0.25 | 100 | 0.7 |
| Sodium | mg/L | | measure | - | - |
| Thallium | ug/L | | 0.8 | 2 | - |
| Uranium | ug/L | | 10 | 10 | - |
| Vanadium | ug/L | | 100 | 100 | 100 |
| Zinc | ug/L | | 13 * | 2000 | 5 |

* Use USEPA Hardness-based or Biotic Ligand Model (BLM) calculations for metals. (Values displayed assume 100 mg/L hardness for temporary reference only)

Notes:

[1] IRMA Fresh Water includes all freshwater uses except Freshwater Aquaculture, which is not a common use around mines. If Freshwater Aquaculture is a use downgradient of a mine discharge, then those criterial apply.

[2] IRMA Ground Water includes Uses for Drinking Water & Human Health, and Agriculture/Irrigation.

| | | Protective of All IRMA Uses | | |
|---|---|---|---|---|
| | | FRESHWATER | | MARINE |
| | Units | IRMA All Fresh Water[1] | IRMA Ground Water[2] | IRMA Marine Water |
| OTHER CONSTITUENTS | | | | |
| Alkalinity (as $CaCO_3$) | mg/L | 350 | 350 | - |
| Ammonia ($NH_3$ as N) | mg/L | 0.01 | 0.02 | 0.02 |
| Chlorine (as $Cl_2$) | ug/L | 0.1 | 0.1 | 0.5 |
| Chloride | mg/L | 113 | 113 | 120 |
| Cyanide (Free or WAD) | ug/L | 5 | 100 | 1 |
| Dissolved Organic Carbon | mg/L | measure | - | - |
| Dissolved Oxygen | mg/L | 5 | - | - |
| Fecal Coliform / E Coli | MPN / 100mL | 0 | 0 | - |
| Fluoride | mg/L | 1 | 1 | 1.16 |
| Hardness | mg/L | 500 | - | - |
| Hydrogen Sulfide (as S2-) | ug/L | 0.05 | 0.05 | 2 |
| Nitrate & Nitrite (as N) | mg/L | 10 | 10 | - |
| Nitrate ($NO_3$ as N) | mg/L | 2.3 | 10 | 4 |
| Nitrite ($NO_2$ as N) | mg/L | 0.06 | 1 | 0.03 |
| pH | s.u. | 6.5 - 8.4 | 6.5 - 8.4 | 7.0 - 8.5 |
| Phosphorus | mg/L | 0.025 | 0.025 | 0.062 |
| Sulfate | mg/L | 250 | 250 | - |
| Temperature | degC | $\Delta < 3$ | - | $\Delta < 3$ |
| Total Dissolved Solids | mg/L | 450 | 450 | - |
| Total Suspended Solids | mg/L | 15 | 50 | 10 |

Notes:

[1] IRMA Fresh Water includes all freshwater uses except Freshwater Aquaculture, which is not a common use around mines. If Freshwater Aquaculture is a use downgradient of a mine discharge, then those criterial apply.

[2] IRMA Ground Water includes Uses for Drinking Water & Human Health, and Agriculture/Irrigation.

## 2) Criteria by Designated Water Use

| | | FRESHWATER | | | | | FRESH WATER | MARINE | |
|---|---|---|---|---|---|---|---|---|---|
| | Units | Aquatic Fresh Water | Drinking Water & Human Health | Agriculture & Irrigation | Recreational | Industrial | Freshwater Aquaculture[1] | Aquatic Salt Water | Marine Aquaculture |
| METALS / METALLOIDS | | | | | | | | | |
| Aluminum | ug/L | 55 | 100 | 5000 | - | - | 30 | - | 10 |
| Antimony | ug/L | 9 | 6 | - | 6 | - | - | - | - |
| Arsenic | ug/L | 20 | 10 | 100 | 10 | 40 | 50 | 12.5 | 8 |
| Barium | ug/L | - | 2000 | 300 | 700 | 3000 | - | 700 | - |
| Beryllium | ug/L | - | 4 | 100 | - | - | - | - | - |
| Boron | ug/L | 750 | 2400 | 500 | 500 | 3000 | 750 | - | 750 |
| Cadmium | ug/L | 1.8 * | 5 | 5 | 3 | 5 | 0.2 | 0.12 | 0.12 |
| Calcium | mg/L | measure | - | - | - | - | - | - | - |
| Chromium (Total) | ug/L | - | 50 | 100 | 50 | - | - | - | - |
| Chromium (III) | ug/L | 8.9 | - | 4.9 | 10 | - | - | 27 | - |
| Chromium (VI) | ug/L | 1 | - | 8 | - | 20 | 20 | 1.5 | 2 |
| Cobalt | ug/L | - | - | 50 | - | - | - | 1 | - |
| Copper | ug/L | 2.4 * | 2000 | 200 | 200 | 50 | 1 | 1.3 | 3 |
| Iron | ug/L | 300 | 300 | 5000 | 300 | 7500 | 10 | - | 2 |
| Lead | ug/L | 2.5 * | 10 | 50 | 10 | 30 | 2.5 | 4.4 | 8.1 |
| Lithium | ug/L | - | - | 2500 | - | - | - | - | - |
| Magnesium | mg/L | measure | - | - | - | - | - | - | - |
| Manganese | ug/L | 430 | 50 | 200 | 100 | 2000 | 10 | - | 10 |
| Mercury | ug/L | 0.06 | 1 | 2 | 1 | 1.8 | 0.77 | 0.1 | 0.016 |
| Molybdenum | ug/L | 73 | 50 | 10 | - | - | - | - | - |
| Nickel | ug/L | 52 * | 20 | 200 | 20 | 74 | 52 | 7 | 5 |
| Potassium | mg/L | measure | - | - | - | - | - | - | - |
| Radium 226/228 | pCi/L | - | 13.5 | 54 | - | - | - | - | - |
| Selenium | ug/L | 1 | 50 | 20 | 10 | 40 | 5 | 71 | 10 |
| Silver | ug/L | 0.25 | 100 | - | 50 | - | 3 | 1.4 | 0.7 |
| Sodium | mg/L | measure | - | - | - | - | - | - | - |
| Thallium | ug/L | 0.8 | 2 | - | - | - | - | - | - |
| Uranium | ug/L | 15 | 30 | 10 | 20 | - | - | - | - |
| Vanadium | ug/L | - | - | 100 | 100 | - | 100 | 100 | 100 |
| Zinc | ug/L | 13 * | 3000 | 2000 | 2000 | 120 | 5 | 8 | 5 |

* Use USEPA Hardness-based or Biotic Ligand Model (BLM) calculations for metals. (Values displayed assume 100 mg/L hardness for temporary reference only)

Notes:

[1] IRMA Fresh Water includes all freshwater uses except Freshwater Aquaculture, which is not a common use around mines. If Freshwater Aquaculture is a use downgradient of a mine discharge, then those criterial apply.

[2] IRMA Ground Water includes Uses for Drinking Water & Human Health, and Agriculture/Irrigation.

| | | FRESHWATER | | | | | FRESH WATER | MARINE | |
|---|---|---|---|---|---|---|---|---|---|
| | Units | Aquatic Fresh Water | Drinking Water & Human Health | Agriculture & Irrigation | Recreational | Industrial | Freshwater Aquaculture[1] | Aquatic Salt Water | Marine Aquaculture |
| OTHER CONSTITUENTS | | | | | | | | | |
| Alkalinity (as $CaCO_3$) | mg/L | measure | - | 350 | - | - | ≥20 | - | - |
| Ammonia ($NH_3$ as N) | mg/L | 0.01 | 0.02 | - | 0.06 | 0.3 | 0.02 | 0.03 | 0.02 |
| Chlorine (as $Cl_2$) | ug/L | 0.5 | 0.6 | 0.1 | - | - | 2 | 0.5 | 2 |
| Chloride | mg/L | 120 | 250 | 113 | 250 | 400 | - | 120 | - |
| Cyanide (Free or WAD) | ug/L | 5 | 200 | 100 | 8 | 200 | 5 | 1 | 1 |
| Dissolved Organic Carbon | mg/L | measure | - | - | - | - | - | - | - |
| Dissolved Oxygen | mg/L | 5 | - | - | - | - | - | - | - |
| Fecal Coliform / E Coli | MPN / 100mL | - | 0 | - | - | - | - | - | - |
| Fluoride | mg/L | 1 | 1.5 | 1 | - | 2 | 20 | - | 1.16 |
| Hardness | mg/L | measure | - | - | 500 | - | - | - | - |
| Hydrogen Sulfide (as S2-) | ug/L | 2 | 0.05 | - | 50 | 50 | 1 | 2 | 2 |
| Nitrate & Nitrite (as N) | mg/L | measure | 10 | 100 | - | - | - | - | - |
| Nitrate ($NO_3$ as N) | mg/L | 3 | 10 | - | 2.3 | 15 | 3 | 45 | 4 |
| Nitrite ($NO_2$ as N) | mg/L | 0.06 | 1 | 10 | 0.3 | - | 0.03 | - | 0.03 |
| pH | s.u. | 6.5 - 9.0 | 6.5 - 8.5 | 6.5 - 8.4 | 6.5 - 8.5 | 6.8 - 8.5 | 6.5 - 9.0 | 7.0 - 8.5 | 6.0 - 8.5 |
| Phosphorus | mg/L | 0.025 | 0.025 | 0.025 | 0.025 | - | 0.025 | 0.062 | 0.062 |
| Sulfate | mg/L | - | 250 | 1000 | 250 | 500 | - | - | - |
| Temperature | degC | $\Delta < 3$ | - | - | - | $\Delta < 3$ | $\Delta < 3$ | $\Delta < 3$ | $\Delta < 3$ |
| Total Dissolved Solids | mg/L | - | 500 | 450 | 1000 | - | - | - | - |
| Total Suspended Solids | mg/L | 15 | - | 50 | 30 | 70 | 40 | 15 | 10 |

Notes:

[1] IRMA Fresh Water includes all freshwater uses except Freshwater Aquaculture, which is not a common use around mines. If Freshwater Aquaculture is a use downgradient of a mine discharge, then those criterial apply.

[2] IRMA Ground Water includes Uses for Drinking Water & Human Health, and Agriculture/Irrigation.

## ANNEX 4.3-B: Water Monitoring Guidance

### 1. Locating and Documenting Water Monitoring Sites

Water monitoring sites are located in areas not affected by project-related activity and releases (for baseline and background sites) and in areas potentially affected by project-related activity and releases (for assessment sites). The conceptual site model in Section 4.3.3 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

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

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.

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

Assessment monitoring locations will also include treated effluent and non-industrial stormwater locations.

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

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

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.

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

#### 1.4. Monitoring location information

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).

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

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

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

### 2.2. Elements of the sampling and analysis plan

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-custody[58] (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 4.3.5.2).

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

### 3.1. Sampling frequency

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.

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.
      - 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.

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:

$$Q_s = 0.85\ A\ v$$

where: $Q_s$ = 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

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.

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.

Measure and record the following field parameters: pH, specific conductance, temperature, and redox potential (if applicable).

Collect the groundwater sample.

Preserve, store, and transport the groundwater samples to an analytical laboratory for analysis.

References:

State of New Mexico, 2013. New Mexico Administrative Code (NMAC), Title 20 – Environmental Protection. Chapter 6 – Water Quality. 20.6.7. Ground Water Protection – Supplemental Permitting Requirements for Copper Mine Facilities. Available: https://www.srca.nm.gov/nmac-home/nmac-titles/title-20-environmental-protection/chapter-6-water-quality/

U.S. Environmental Protection Agency (EPA), 2023. Groundwater Sampling. Region 4. Laboratory Services & Applied Science Division, Athens, Georgia. Operating Procedure LSASDPROC-301-R6. April 22. 36 pgs. Available: https://www.epa.gov/sites/default/files/2017-07/documents/groundwater_sampling301_af.r4.pdf

U.S. Environmental Protection Agency (EPA), 2023. Surface Water Sampling. Region 4. Laboratory Services & Applied Science Division, Athens, Georgia. Operating Procedure LSASDPROC-201-R6. April 22. 18 pgs. Available: https://www.epa.gov/sites/default/files/2017-07/documents/surface_water_sampling201_af.r4.pdf

U.S. Geological Survey, 2006. Collection of Water Samples (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chap. A4, September. Available: https://pubs.usgs.gov/twri/twri9a4/twri9a4_Chap4_v2.pdf

U.S. Geological Survey, 1968. General Procedure for Gaging Streams. Techniques for Water-Resources Investigations, Book 3, Chapter A6, By R.W. Carter and Jacob Davidian. https://pubs.usgs.gov/twri/twri3-A6/

Wilde, F.D., ed., variously dated, Field Measurements: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chap. A6. Available: https://pubs.usgs.gov/twri/twri9a6/twri9a6_final508ChapterA6.pdf

[58] 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.

**2025 – Initiative for Responsible Mining Assurance**

www.responsiblemining.net

IRMA Initiative for Responsible Mining Assurance