AUA CENTER *for* RESPONSIBLE MINING

MINING MONITORING TOOLKIT

GUIDE TO ENVIRONMENTAL, HEALTH, SOCIAL, DISASTER RESILIENCE, AND ECONOMIC ASPECTS OF MINING

For youth, civil society, NGOs, local authorities, and other interested stakeholders

crm.aua.am

USAID FROM THE AMERICAN PEOPLE

TRANSPARENCY INTERNATIONAL anticorruption center

MINING MONITORING TOOLKIT: Guide to Environmental, Health, Social, Disaster Resilience, and Economic Aspects of Mining; For youth, civil society, NGOs, local authorities, and other interested stakeholders, 2022 Yerevan. AUA Center for Responsible Mining. 58 pages.

ISBN 978-9939-1-1426-2

Table of Contents

Acknowledgments

The AUA Center for Responsible Mining has developed this Toolkit within the scope of the Mining Policy Dialogue, Information Portal, and Youth Engagement (MPDPY) project as a subgrantee to Transparency International Anti-Corruption Center in Armenia with funding from the US Agency for International Development. The AUA Center for Responsible Mining team producing this Toolkit includes:

Content:
Vicken Aprahamian, Alen Amirkhanian, Marine Voskanyan, Harutyun Movsisyan, Alexander Arakelyan, and Vardan Hayrapetyan

Graphic Design:
Astghik Karapetyan

English Copy Editing:
Brent A. Anders

Translation English to Armenian:
Emma Nemishalyan

Project Manager:
Alexander Arakelyan

Grant Manager:
Siranush Harutyunyan

Within the scope of the same project, the AUA Center for Responsible Mining has also developed http://mininginfo.am web portal, which offers data and information, useful for community monitoring of mining activities and impacts. In addition, as part of the project, the Center commissioned four policy papers on key issues and challenges facing mining in Armenia. The policy papers and summaries of subsequent discussions are available in Armenian and English at https://crm.aua.am/mpdpy/mining-policy-dialog-process.

1. Introduction

Environmental, health, social, disaster resilience, and economic (EHSDE) responsibilities are at the forefront of attention in all economic sectors, including mining and mineral processing. In all jurisdictions, there are laws and regulations that govern the mining sector, which to varying degrees assign environmental, health, and social responsibility to business as well as national and local authorities. In many countries, including Armenia, there are challenges in ensuring that legally required obligations concerning to EHSDE responsibilities are met. Also, as legal systems are living and evolving systems and there is a growing body of global best practice and guidelines, there is a need to introduce and advocate for improvement of legislation regarding EHSDE responsibilities. This is an essential part of helping a country develop into a modern, developed economy where citizens and communities' welfare are at the forefront of economic policy.

Issues surrounding the economic responsibilities of mining are also key to consider. Mining companies have a significant economic role in a regional or national economy. In the case of Armenia, while the share of mining in the national economy is small--about 3% of GDP for the past decade, the sector has played a significant role in the total value of goods exported from Armenia, contributions to the state revenues, and high concentration of employment in certain regions of Armenia (particularly Syunik). All these raise many questions on the long-term management of a non-renewable resource like minerals for the long-term development of the country and the regions. Many countries, including those with metal mines, have decided to set up sovereign wealth funds, which transform the non-renewable resources into a "renewable" financial resource for their country. Since 2017, Armenia has adopted the Extractive Industries Transparency Initiative (EITI) financial transparency standards in the mining sector. EITI's annual reports and databases should offer information for further exploration of the economic aspects and impacts of mining and how they can be improved.

The issues of disaster resilience in the mining communities of Armenia are directly related to disaster risk reduction on the site (such as by having safe structures and ensuring safe production processes) as well as response and recovery readiness in case of disasters. Improving disaster resilience is a key factor in the development of the state, whose key tasks are to improve the effectiveness of measures aimed at preventing, managing, responding to, and eliminating the consequences of disasters. Within mining communities in particular, the latter requires comprehensive and coordinated action by the Government and several government agencies, local government, mining operators, scientific institutions, and civil society.[1]

Citizen and civil society participation can be a powerful tool to promote regulatory compliance and propose regulatory improvements in all directions mentioned above. This Toolkit is designed to inform and equip citizens and civil society organizations to participate in advancing the environmental, health, social, and economic development of their mining-affected communities. As such, this Toolkit can also be useful for local authorities, which are often in need of technical capacity and know-how to promote the EHSDE interests of their communities at the regional and national levels as well as in relation to mining operators. This Toolkit aims to:

[1] *https://crm.aua.am/files/2021/05/Discussion_Paper_Disaster_Resilience_EN.pdf*

- Promote constructive discussions between communities, mining companies and government bodies
- Highlight sustainable development issues with the best possible outcomes at the local level from the onset
- During the different phases of a project, facilitate socio-economic improvements with the vision of how to maintain them, even after the end of the project
- Address any deviations occurring during a phase in a project cycle through smooth stakeholder discussions to develop corrective actions
- Act as a reference for safety around abandoned mining and quarrying sites

The Toolkit is structured into several sections. The main body of the Toolkit presents some of the key terms that those monitoring mining activities should be familiar with. It then offers an overview of each of the phases in the life cycle of mines, especially metal mines, starting from exploration and ending with post-closure maintenance. In each section, particular attention is paid to the EHSDE risks, responsibilities, and mitigation measures. The Toolkit also offers 4 important and useful Annexes:

- Annex 1 includes a checklist that the civil society and municipalities can use to monitor EHSE conditions in their communities
- Annex 2 includes tables with detailed information on impacts, durations, and mitigations measures for the various activities in the mining process
- Annex 3 lists links describing the Environmental, Health, and Social Management System per international practices as outlined by the International Finance Corporation (IFC), European Bank for Reconstruction and Development (EBRD), Dutch entrepreneurial development bank (FMO), Extractive Industries Transparency Initiative (EITI), Commonwealth Development Corporation (CDC), Global Legal Group (GLG), and more
- Annex 4 provides the list of mining-related laws, codes, sub-legislative acts, regulatory bodies, and more

2. Key Concepts and Terms

In this section, we will present and briefly describe each of the key concepts and terms related to the mining sector. It is essential that those engaged in monitoring or discussing the sector, its activities, and impact, are familiar with these concepts and terms. The terms and concepts discussed (in alphabetical order) include:

1) Acid Mine Drainage
2) Alloys
3) Disaster Preparedness
4) Disaster Resilience
5) Geochemical Background Concentrations
6) Heavy Metals
7) Hydro-metallurgy
8) Maximum Allowable Concentrations
9) Mineral
10) Mineral Processing Technologies
11) Mining
12) Mineralization
13) Ore
14) Ore Concentrate (or simply Concentrate)
15) Overburden (Waste Rock)
16) Site Recultivation (also known as Reclamation or Restoration)
17) Smelting
18) Tailing Storage Facility
19) Tailings
20) Toxicity

1) Acid Mine Drainage

Acidic mine drainage (AMD) is the run-off of highly acidic water from mine waste dumps, tailings ponds, and open or underground mine sites containing sulfide minerals.[2]

AMD is one of the major environmental consequences of mining activity that often causes complete degradation of the ecosystems during and/or after mine closure. At metal mines, the target ore (like those for gold, silver, copper, iron, etc.) is often rich in sulfide minerals.

When the mining process exposes the sulfides to water and air, together they react to form sulfuric acid. This acid can dissolve other harmful metals and metalloids (like arsenic) from the surrounding rock, increasing the levels of heavy metals to toxic levels.

AMD can be easily identified by the orange sediment in surface waters. Acid mine drainage is mining's most serious threat to water resources. A mine with acid drainage has the potential for long-term devastating impacts on rivers, streams, and aquatic life. AMD can occur indefinitely — long after mining has ended.

---

[2] *The section on AMD relies primarily on information available on Earthworks.org website: https://www.earthworks.org/issues/acid_mine_drainage.*

2) Alloys

An alloy is a combination of a metal with at least one other metal or nonmetal. Alloys have desirable properties such as greater strength, resistance to corrosion, greater resistance to heat, etc.

3) Disaster Preparedness

Mining-related disasters can occur from a variety of causes, including tailing dam failures, mining-induced seismicity, flooding, leaks of poisonous gases such as hydrogen sulfide or dust explosions, and other human-made or natural occurrences.

Disaster preparedness refers to measures taken to prepare for and reduce the effects of disasters. That is, to predict and—where possible—prevent them, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences. This includes but is not limited to the engagement of citizens in planning and disaster simulations, exercises, and drills.

Disaster preparedness is best viewed as a long-term and institutionalized commitment to be ready for disasters rather than something that is done just before responding to disasters.

4) Disaster Resilience

Disaster resilience is the ability to prevent, withstand, and recover from the harmful impacts of human-made or natural disasters' hazards. Resilience is different from preparedness in that there are expectations of recovery. The level and speed of recovery will have to be defined by those planning for disasters, national legislation, available resources, and the like. In planning and preparing for disaster resilience, it is critical to include all key stakeholders, including the views and interests of a wide variety of citizens from different age groups, occupations, socio-economic groups, and more. Mining communities must always have disaster resilience plans.

5) Geochemical Background Concentrations

The average concentrations of chemical elements in rocks, soils, waters, gases, and plants, the chemical composition of which was not affected by ore-forming concentration processes. The values of the background concentration serve as reference standards for identifying local objects with abnormally high (or abnormally low) element contents.

6) Heavy Metals

A general term used to describe metallic elements which are toxic to human or animal health at minute doses. It typically refers to many common metals such as copper, zinc, molybdenum, lead, but also includes the more toxic cadmium, arsenic, mercury, thallium and beryllium.

7) Hydro-metallurgy

Wet chemical techniques or *hydro-metallurgy* can replace *smelting*. Acidic and basic solutions are used for dissolving metals away from concentrate in large vats with mixers. Once metal is dissolved, it is recovered in a purer solid form through additional chemical steps. Hydro-metallurgy also includes the final steps of refining to commercial grades of metal.

Heap Leaching is a form of hydro-metallurgy **-** carried out without fine grinding and flotation; the crushed ore is placed in heaps on thick plastic liners by large trucks. The heaps are then exposed to a chemical solution sprayed over the top surface. The chemical solution cascades through the heap and dissolves metals. The metal-rich chemical solution is collected at the base of the heap in a plastic-lined pool and is then further processed to recover the metal in a pure and solid form.

All hydro-metallurgical processes have a used process water treatment plant and some even recycle the treated water in-house. Treated waters are released to sewers if they conform to state contaminant concentration limits.

Waste solids from hydro-metallurgical processes must be disposed of safely either in tailings ponds or shipped to other facilities for treatment and safe disposal.

8) Maximum Allowable Concentrations

These are strict government regulations that define maximal limits of dissolved element concentrations within spent waters released from industrial facilities. Approved sampling methods must be followed in the same way as done for Geochemical Background Concentration determinations.

9) Mineral

A mineral is a solid, naturally occurring substance that has a fairly well-structured, crystalline chemical composition. A mineral can contain 1 or more elements. Diamond, for instance, only has 1 element, viz., carbon. Gypsum, on the other hand, is composed of a unique combination of 4 elements, viz., calcium, sulphur, hydrogen, and oxygen. The International Mineralogical Association (IMA) is the organization that sets standards on minerals. As of July 2021, the IMA recognizes 5,721 official mineral species.

10) Mineral Deposit

A geologic area that is known to be rich in minerals useful to society. The zone can be localized at shallow or at great depth from the ground surface. If the zone is of economic value, it is referred to as an **ore deposit**. Mineral Deposit also relates to how the metal or value exists in the ground as it seldom exists in natural metallic form but in a form bound to other elements. Metal ores usually occur in association with sulfur or with oxygen.

11) Mineral Processing Technologies

In most cases, metal-rich rock (the ore) is delivered to a facility very close to the mine where the rock is crushed then ground to a powder. The powdered ore is then subjected to a *flotation* process, which "floats" the powder in water that has chemicals that facilitate the separation of the valuable metals. The valuable metals are then collected. This metal-rich portion, also known as *concentrate*, is dried before being loaded onto rail cars or trucks to transport to a metal refining plant which may be located many kilometers away or even in a different country.

Other than the metal-rich portion, there is a good amount of remaining materials from the powder input. These are called tailings (see definition). The tailings are then sent to a Tailings Storage Facility (see definition).

In the case of stones and aggregates, the fragmented rock may or may not be ground to a powder in a mill depending on end uses and market conditions. Flotation is seldom used for this purpose.

12) Mining

Mining and quarrying are activities for the extraction of **ore,** which is metal-rich rock. Salts and mineral stones can also be obtained through rock excavation. Metals and salts are essential to our society for the fabrication of machines, buildings, and chemicals. Metals with high value such as gold and silver are stored in vaults once refined and bring monetary security to a country in times of crisis.

Quarrying of stones and aggregates, known as non-metallic minerals, is important for the construction of buildings, bridges, and roads; examples of these are limestone, clay, tuff, marble, obsidian, silica, quartz, and granite. Both mining and quarrying usually take place at a distant location from a city or may even be located within the limits of a city out of sight of passers-by.

The method of mining can be open pit or underground. Open pit mining takes layers of soil and rock from the surface until it gets to the minerals or ores. An underground mine, on the other hand, is used when the ores are deep in the ground. To access the ores, in an underground mine tunnels and shafts are dug to go deep into the ground. Sometimes an open pit mine can start using underground mining after the easily accessible minerals or ores in the surface are exhausted.

13) Ore

Ore is natural rock or sediment that contains one or more valuable minerals, typically containing metals, that can be mined (see Mining Techniques), treated (see Mineral Processing), and sold at a profit.

14) Ore Concentrate (or simply Concentrate)

Concentrate is the metal of value that is extracted from the processing of ores using crushing and chemical processes. Concentrates, when dried, are in powder form, which is then sent to further processing and refinements for use in products.

15) Overburden (Waste Rock)

Rock and soil that are on top of the orebodies. Overburden is different from tailings (see description in this section). The overburden has no commercial value but must be removed to gain access to the ore bodies. Once removed, overburden must be safely transported, deposited, and stored in designated areas. The overburden can later be used in land reclamation and ecosystem restoration. Management of overburden has its own environmental and safety considerations that must be taken into account.

16) Site Recultivation (also known as Reclamation or Restoration)

Activities that enable the impacted landscapes and ecosystems of the mining site to be restored. Mine reclamation should be an ongoing program designed to restore to an acceptable state the physical, chemical, and biological quality or potential of air, land, and water regimes disturbed by mining. The objective of mine reclamation is to prevent or minimize adverse long-term environmental impacts and create a self-sustaining ecosystem as near as practicable to what existed before the mining activity.[3]

17) Smelting

Dried metal-containing concentrate is burnt with oxygen to vaporize sulphur and separate metallic values from impurity metals. This is the first step in metal refining. This activity takes place in large furnaces at a *smelter*. A smelting process can also be a single processing step used in *smaller metal refineries or foundries.*

Smelters and foundries treat any process waters for contaminants before releasing them into sewers. They are also required to recover any dust in emissions as well as toxic gases. State regulations apply for spent waters and air emissions from stacks. Dust and by-product slags from the smelting may be retreated to recover further values and/or disposal or shipped off-site for safe disposal.

18) Tailing

Tailings are the residues of ore (ground-up rock, sand, and silt) remaining after the extraction process. Tailings could have some residual metals, but it is deemed uneconomical for further extraction. These metals can be a source of land and water pollution if not managed properly.

Modern extraction processes and technologies have high rates of metal extraction, leaving relatively small amounts of metals in the tailings. Older tailings sites, however, are expected to have higher metal concentrations as the technologies in, say the 1950s, were not as efficient as they are today. There are ongoing global discussions and explorations to "re-mine" old tailing sites.

Tailings can be sent to storage in three different forms: slurry (or conventional), paste, and dry.[4]

Slurry: The most common disposal type for tailings has been in the *slurry* form, also referred to as the conventional form. The slurry form has a high-water content (40%-80%) making it easier to transport via pipes and ducts either using gravity or pumping. In Armenia, slurry tailings have been the only type of tailings to date. The slurry also contains many of the hazardous chemical substances used in the metal separation process. Storing this slurry has special facility requirements, which are discussed further in the section on tailing storage facility (TSF).

Paste: To obtain paste tailings, the residues are dewatered to an extent that they become like toothpaste (20%-35% water). To get this thick consistency, often additives such as flocculants and coagulants are also added to the mixture. Given the low water content, special pumps must be used to move paste tailings, which may also limit the distance they can be moved feasibly. On the other hand, paste tailings enable enormous water savings. Moreover, there will be significant savings from eliminating the need for tailings dams and all the risks associated with them. The paste can also be used to pump back into tunnels and cavities created by underground mining.[5]

Dry stack: For dry stack, tailings are dewatered to higher degrees than paste, producing a mixture that contains 20% or less water. These dried "cakes" can no longer be transported by pipelines and instead need conveyor belts and trucks. Once delivered to the deposit site, they are spread and compacted. This type of tailings storage produces a stable deposit usually requiring no retention or dams. There is also no seepage or toxic water associated with dry stacking.

---

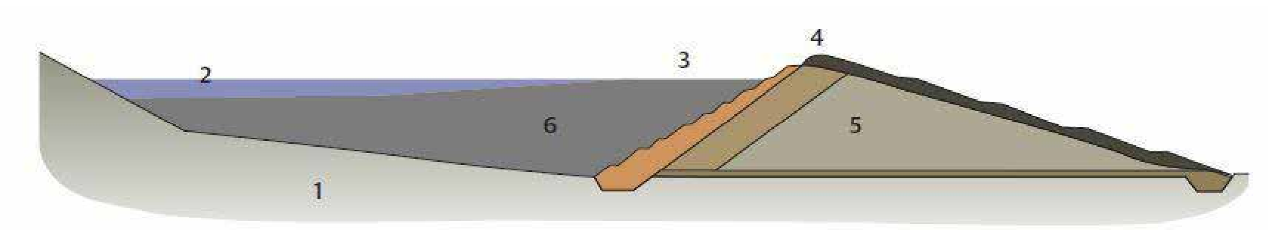
3 *https://www.eea.europa.eu/help/glossary/gemet-environmental-thesaurus/mining-site-restoration*

4 *The information on different disposal forms of tailings see tailings.info.*

19) Tailing Storage Facility

A tailings storage facility (TSF), typically used for storing slurry tailings (see section on "tailings"), is a structure made up of (one or more dams) built for the purposes of storing the tailings slurry--the uneconomical ore (ground-up rock, sand, and silt), water, and the chemicals from the milling and extraction process.[6] TSF's designed for slurry tailings has been the predominant way of storing tailings in Armenia.

A TSF is a highly engineered structure with several typical components shown in Figure 1. The first component (#1) is the natural ground on which the facility is built. When the tailings slurry (#6) is deposited in the TSF, it will come into contact with #1. As the slurry has lots of water, chemicals, and heavy metals, depending on the characteristics of the natural ground, the polluted water may seep through, polluting the soil and the underground water table. To prevent or minimize this, in many countries, mining companies are required to place clay layers, liners, and the like. Some of the new tailing dams constructed in the past ten years follow similar TSF floor standards; older tailing dams, however, basically do not.



Source: OceanaGold-Waihi, New Zealand. Tailing Storage Facilities. https://www.waihigold.co.nz/mining/waste-rock-and-tailings/tailings-storage-facilities/
Note: 1 = natural ground; 2 = decant pond; 3 = beach; 4 = crest; 5 = zone embankment including starter dam; 6 = deposited tailings.

Figure 1. Typical Components of Tailing Dams

National legislation and standards also inform how a TSF, including the tailing dam (#5), is to be designed, built, inspected, and managed. Note that #4, namely the crest of the dam, stands significantly higher than the beach area (#3). This is to avoid overflow of toxic water and tailings in case of high levels of precipitation. Such overflows can undermine the stability of the dam as well as present point sources of toxic pollution to the immediate environment of the dam.

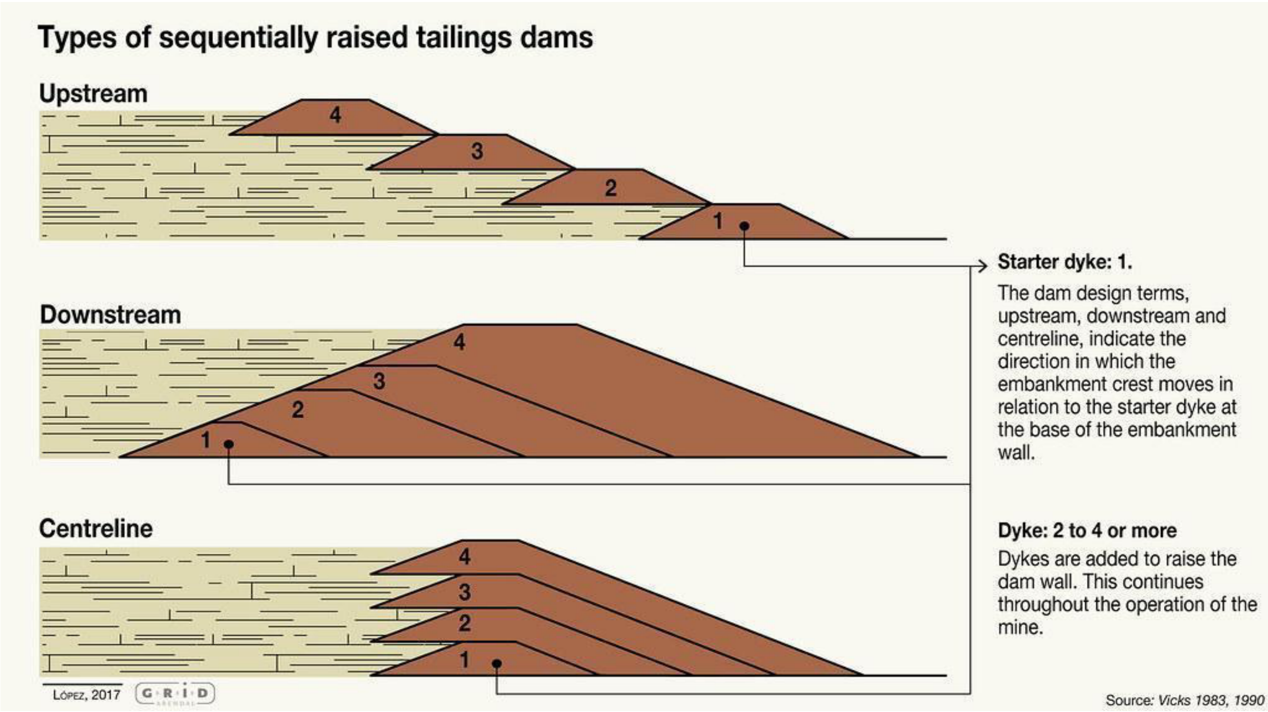
The proper design, construction, monitoring, and maintenance of these dams is critical to avoiding dam failures, which can have catastrophic consequences for humans and the environment.

5 https://www.tailings.info/storage/backfill.htm
6 World Bank. 2021. Tailings Storage Facilities. Good Practice Note on Dam Safety;Technical Note 7. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/35491

As the tailings are deposited into the engineered TSF over time, much of the water separates from the fine particles (either naturally through sedimentation or a mechanized process). In depositing the tailings into the dam, the operator must ensure that the deposited tailings sediments (#6) sloped away from the dam. This is to ensure that water is pushed away from the dam, reducing the risk of dam failure. There are engineering standards and calculation methods for how long the beach (#3) should be for the safe operation of the TSF. It is critical that these standards and methods are regularly reviewed and updated to be aligned with global best practices.

As the water is pushed away from the dam, what is formed is called the decant pond (#2). While this water partially evaporates, most of it is drained away. Ideally this drained water is recycled back into the mine to be used for the flotation process. This, however, does not typically happen in Armenia.

There are three main types of tailings dams (#5): downstream, upstream, and centerline (see Figure 2).[7] Deciding which type of dam to build depends on many factors including local climate, topography, soil and geological conditions, and seismic risks. It should be noted that all TSF dams in Armenia are constructed with the upstream method, which is not recommended for mountainous countries with high seismic activity.



Source: *https://www.grida.no/resources/11422*

Figure 2. Different types of tailing dam design

7 *Ibid.*

The plan to manage a TSF is an essential part of the Environmental Impact Assessment (EIA) approval process in most countries. It is critical that tailings design, construction, and management follow international best practices and technologies as the consequences of dam failures can be catastrophic. In response to the increased large-scale and catastrophic tailing dam failures, three major international organizations[8] formed the Global Tailings Review to explore setting global standards on tailings management, including all related facilities. After 1.5 years of intensive research and multi-stakeholder consultations, in August 2020, the Global Tailings Review published the Global Industry Standard on Tailings Management. The Standard, available in seven languages including English and Russian, is organised around six topic areas, 15 principles, and 77 auditable requirements. There are many ongoing global discussions about the wider adoption of these or similar standards.

In addition to the above-mentioned global standards, there are other major initiatives to offer guidelines for TSFs including:

- Australian National Committee on Large Dams (ANCOLD) (latest revisions 2019), available in English
- Mining Association of Canada (MAC), A Guide to Management of Tailings Facilities (Third Edition, 2019), available in English
- United Nations Economic Commission for Europe (UNECE)'s Safety Guidelines and good practices for Tailing Management Facilities (2014) available in English and Russian

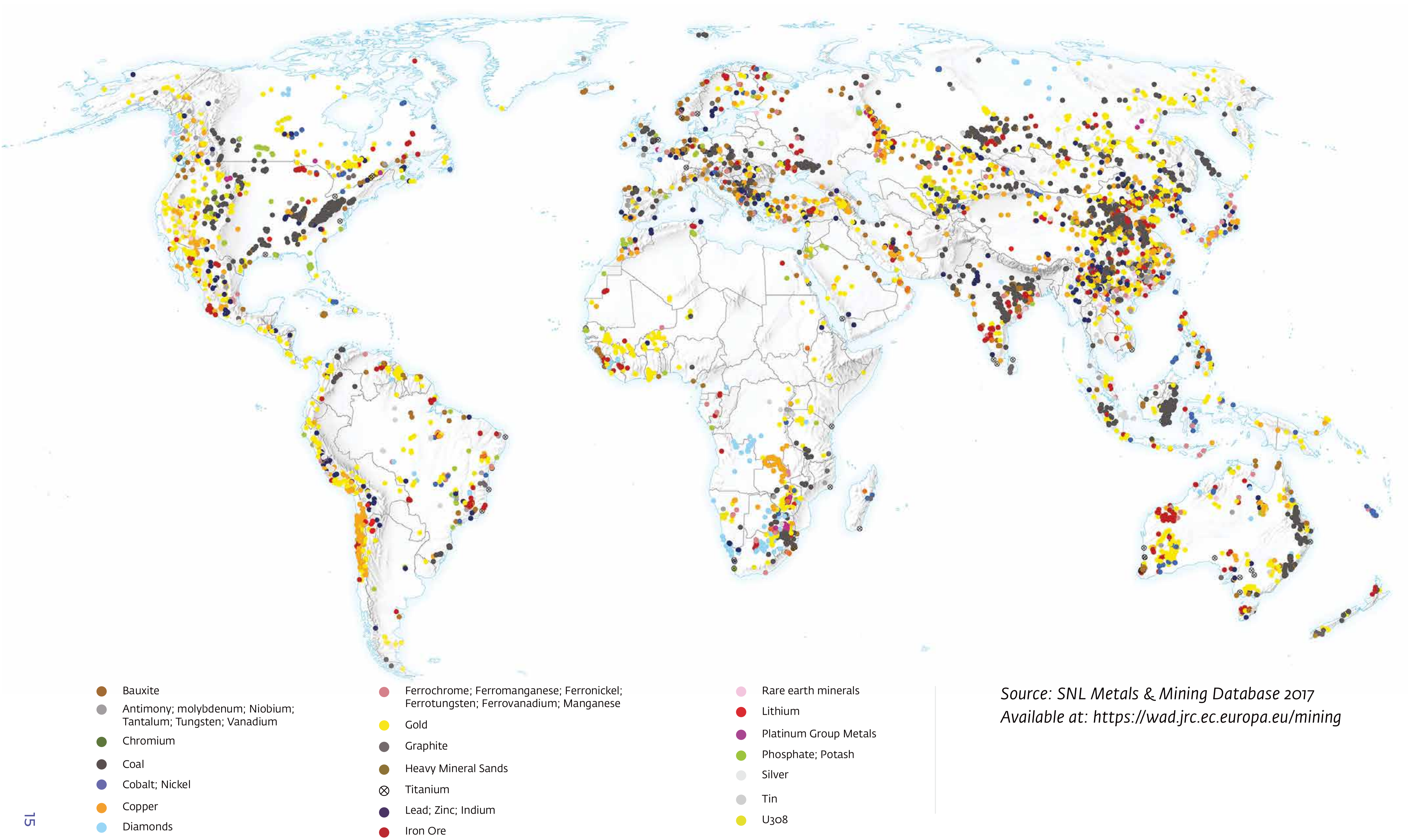
National legislation must regularly review its norms and standards to align itself with global best practices concerning facilities like TSFs that have significant risks associated with them.

20) Toxicity

The degree to which a substance can harm a human or animal body. The maximum limit of exposure is determined in milligrams per kilogram of body weight by medical institutes. Its real degree of toxicity depends on how it is exposed to a human body, generally if dissolved in water or dispersed in the air as a powder it will be much more harmful than if present in a large rock.

[8] *The Global Tailings Review is an initiative co-convened by the International Council on Mining and Metals (ICMM), United Nations Environment Programme (UNEP), and the Principles for Responsible Investment.*

Map of active metal and energy minerals mining sites



Source: SNL Metals & Mining Database 2017
Available at: https://wad.jrc.ec.europa.eu/mining

3. Mining in Armenia

According to the National Academy of Sciences of Armenia's Institute of Geological Sciences, Armenia currently has 871 mineral deposits with confirmed reserves--43 metallic, 760 non-metallic, 44 underground freshwater and 24 mineral waters. These represent more than 130 types of minerals, of which around 25 are metals. Here are additional details about some of these minerals:

- Metallic minerals: iron, copper, molybdenum, lead, zinc, gold, silver, antimony, aluminum ore, and a few others
- Façade and building stones
- Gemstones
- Filling and ballasting raw material
- All-purpose raw material used in the production of concrete, coarse-grain building ceramic, paint, metalware, chemical products, light industry, food industry, and other branches

Modern metal mining activity in Armenia began with copper extraction and dates back to the 18th century. Twenty-eight (28) out of some 400 mineral mines with licenses are metallic. As of September 2021, there are ten (10) active metal mines that produce copper, molybdenum, zinc, and precious metals concentrates: Kajaran, Teghut, Agarak, Sotk, Meghradzor, Shahumyan, Shamlugh, Lichkvas Tey, Archut, and Karabert (see Figure 3).

Most mines produce two or more metal concentrate by-products once the ore is processed at their concentrators. The largest mine is operated in Kajaran by the Zangezur Copper Molybdenum Combine (ZCMC) which processes 22.0 million tons of ore per year.

The concentrates are transported by road and rail to a distant site for primary processing into refined metal or by-products such as an alloy. The smelter or refinery may be in Armenia or a foreign country.

There are 23 tailings dams in the country, with cumulative volume exceeding about 390 million cubic meters and occupying a total area of around 1000 hectares.

There are also several "abandoned" or legacy mines that are scattered around the countryside. The government of Armenia is expected to manage safety around these locations.

Stone and aggregate quarries are present in and around numerous municipalities across the country.

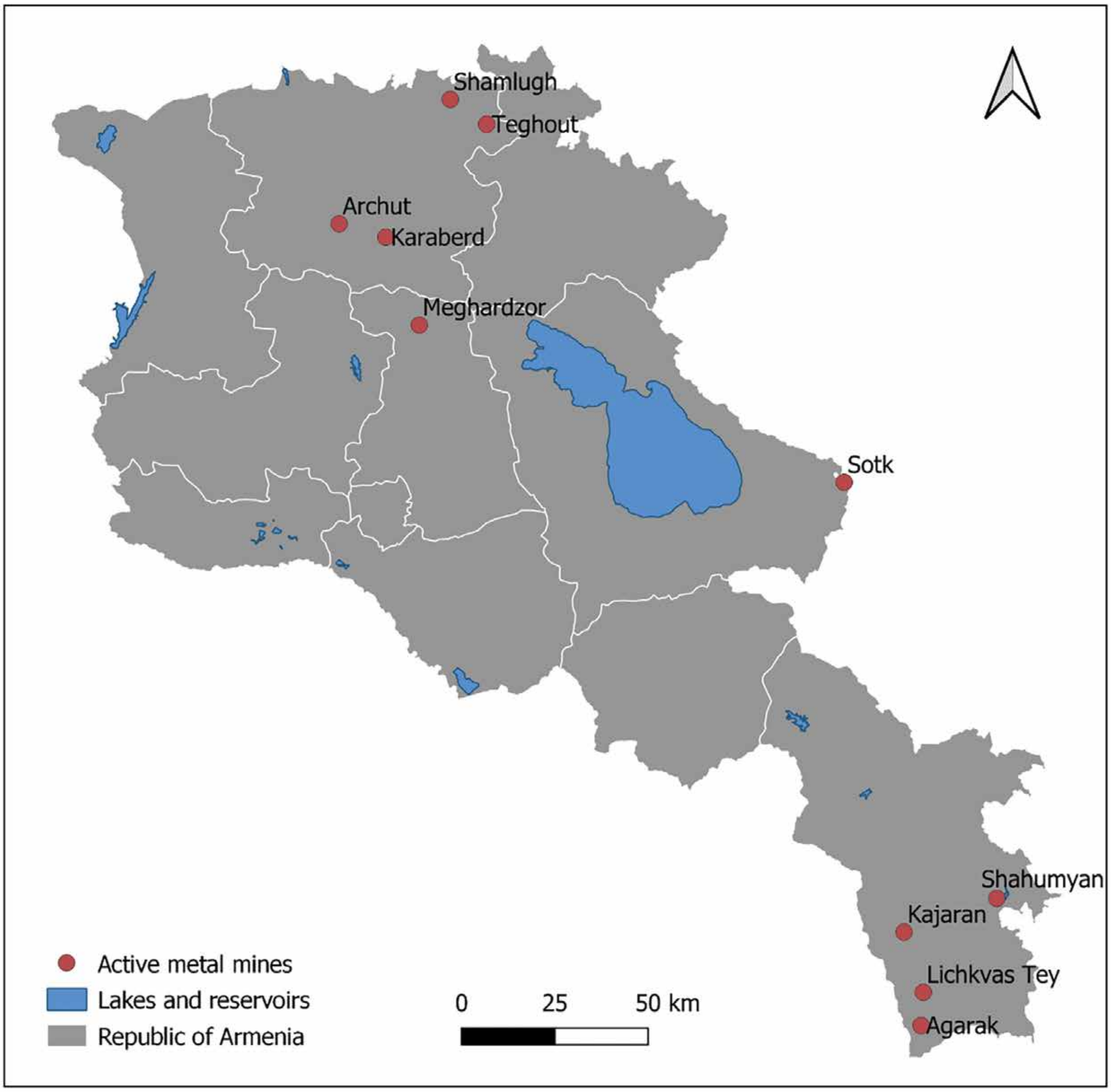


Figure 3. Map of active metal mines of the Republic of Armenia, as of September 2021 (Source: AUA Center for Responsible Mining)

4. Mining Project Life Cycle

Mining is a long-term undertaking. The life-cycle of mining operations, in some cases, spans a hundred years or more. Below are illustrations and brief overview of the phases in a mining project life cycle.

EXPLORATION

Exploration -- In order to commence mining of a land resource, the geology of the area must indicate favorable reserves and concentration of metal so that a company may be able to operate economically over many years. The company initiates an exploration project to complete the first evaluation. This exploration can take up years and includes granting of state exploration permits as the ground needs to be drilled for core samples.

DEVELOPMENT

Development -- Following exploration, if a mining company decides that there are sufficient reserves to exploit the mine, it conducts preliminary financial feasibility, taking into account amounts of reserves, cost of building and maintaining infrastructure, operational costs, and more. If the company deems that the project is feasible, it applies to relevant government authorities to obtain exploitation permits.

FULL PRODUCTION

A key component of the permitting process in many countries, including Armenia, is environmental, health and social assessment. The entire feasibility and permitting process can last 2-10 years, in some cases even more. Mining companies also use this time to secure financing for the project (including equipment, roads, facilities, etc.).

Once permits are obtained, the mine operators begin construction of roads, tailing storage facilities, processing facilities, etc. All of this can last about 2 to 3 years.

RECLAMATION

Operation -- The operating life of a mine or what is often called the exploitation phase begins once the facilities are ready. In this period, the mine operator begins to remove soil and rocks to get to the deposit, remove the ores, process the ores to obtain concentrates, and deliver these concentrates to buyers. Depending on the size of the deposit, the mine can be exploited for up to 100 years or more.

POST - CLOSURE

Closure, Reclamation, and Post-Closure Monitoring -- At the end of the mine life, closure takes place with rehabilitation of the land to return it safely to nature. Very detailed plans are followed and permitting is required. After rehabilitation, the mined area is monitored for several years. Risks to the environment, human health of workers, and communities must be continuously monitored as preventive measures.

In the next sections, the various phases of a mine are further discussed.

5. Exploration — Licensing, Fieldwork, and Cleanup

Geological exploration activities that require mountain excavations and boreholes are allowed only by an authorized body after obtaining a relevant permit. An exploration permit is granted on the basis of an exploration agreement (general geological exploration of the subsoil) or exploration permit for further exploitation, a contract, and an approved work plan.[9]

Some prospecting may be carried out by scientists in the field who may carry out some early re-interpretation through sample collection and verification of rock outcrops. **Prospecting** is a study by walking and making observations on the site.

Upon collection of strong evidence of the existence of ore, the exploration team meets with the local community to take the time to explain the exploration stages which will follow. The building of a strong relationship and communication with the community is key to all stages which will follow.

The exploration stages which follow consist of further pre-exploration involving more sample gathering and analysis, use of geophysical methods to survey the area which is done by flying over the site and using scanning instruments and can also involve ground excavation also known as trenching.

If the pre-exploration stage reveals further strong evidence of mineral presence, the decision is taken to commence the main exploration step which is called **drilling**. Drilling machines are used to pierce and penetrate deep into the ground and withdraw very long cores. These are analyzed at different intervals along a length. This is the method that gives the most accurate evaluation of the shape, depth, and extent of mineralization.

From this data, it is immediately apparent whether an economic zone is present. If not, a re-evaluation must be done, or the project abandoned. Once all drilling is completed and computer modelling evaluations conclude that mineral estimates were close or better than initial estimates, the company concludes with confidence that it has made a discovery.

All areas disturbed by drilling and trenching which were unproductive are returned to their original state by land reclamation methods. Productive land areas remain under company responsibility and monitoring but may not be subject to immediate reclamation though this has its own environmental risks.

To analyze the potential project further, a metallurgical evaluation of samples is done to make sure that processing is manageable. Additionally, 3-D computer modelling is conducted to create a spatial image at depth, to determine the best method of mining, to then carry out a preliminary economic evaluation of the project.

[9] *EITI Legal and Institutional Study: https://www.eiti.am/en/legal-and-institutional-study*

Figure 4 shows how the exploration feasibility study may lead to decisions. Results of exploration may indicate that an orebody is economic, yet if the minerals associated with the metal value are difficult to recover by proven methods, it may lead to mothballing the project until such time that technology evolves. If the results are uneconomic and minerals are treatable, then a decision is taken whether or not to further explore the area.

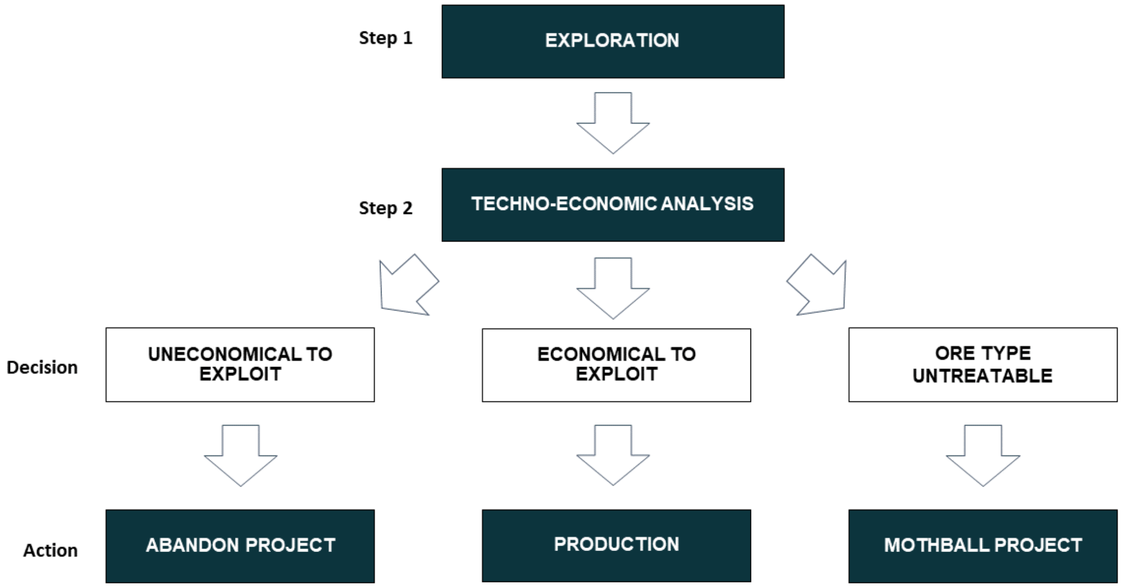


Figure 4. Exploration decision tree

According to the Mining Code[9] and Land Code[10] of RA, the explorer or miner is obligated to restore (recultivate) the explored area impacted by their activities within the timeframes defined by the project's license and the provisions of the associated agreement with the licensing authority.

[10] *RA Mining Code, Chapter 8, Article 70, points 1. ՀՕ-280-Ն:*
https://www.arlis.am/documentview.aspx?docid=126310
[11] *RA Land Code, Chapter 16, Article 83, points 2, 4. ՀՕ-185*
https://www.arlis.am/documentview.aspx?docid=74667

6. Development — Exploitation Licensing

Once exploration is completed and economic reserves determined, the mining company may decide to apply for a mine exploitation permit, without which it will not be able to extract any of the minerals. In Armenia, to obtain a mining permit, the applicant should pass four types of reviews: environmental impact; technical (safety of tailing facilities and other structures); geological (verification of mineral reserves), and business plan (if the company has a viable business plan).

To conduct the EIA study, the mining permit applicant hires an independent consulting engineering company. The purpose of the assessment is to inform government decision-makers about the environmental impacts and mitigation measures, allowing them to decide if the project should proceed or not.

The term 'environmental impact' refers to changes to the landscape, effects on drawing water from local wells and electricity from power stations, making use of roads with heavy trucks, the ecology (fauna and flora), pollution of land, air, and water, damage to heritage sites, as well as effects on communities living in the vicinity. The term particularly outlines how waste produced and waters will be retained or treated, and how monitoring is to be done during mining and after closure.

Part of the package also requires a mine closure plan, returning the area to nature once the mine exploitation ends. The final report is made available to all stakeholders, the government, the mining company, and civil society. Scoping and review of the EIA's have a process defined by legislation. In Armenia, for instance, an EIA requires 4 public hearings, each at a specified stage in the EIA process. The applicant and the government also have requirements for giving proper public notice and publishing relevant documents before the hearing.

The report highlights that well-maintained roads, sufficient electricity, water supply, natural gas, and ease of obtaining chemicals, spare parts, and equipment are important to running an extraction site. The demand for the metal or material for its use in society can also affect its worth and can influence the useful life of a mine.

Assuming the study is approved, with all the other assessments and documents accepted, a mining permit is granted. The company can then start construction work. If important risks cannot be mitigated or major issues arise which cannot be solved easily, it is sometimes recommended that an additional impact assessment be conducted by a second independent and specialized consulting firm.

6.1. Brief note on Environmental Impact Assessment and Expertise

The main aim of Environmental Impact Assessment (EIA) is to evaluate the possible impact of the program on the environment, local communities, and public health, as well as to manage the environmental and social risks throughout the whole project.

The EIA expects the description of the existing conditions of the local environment, providing a comprehensive data collection and analysis of the baseline conditions at the Project site. The baseline data allows for identification of the main socio.environmental factors that might be associated with the Project activities.

EIA is designed to predict the possible positive and negative impacts on the environment throughout the project. The early detection of the impacts further contributes to the proper management of the environmental risks (avoiding, reducing, or improving the adverse consequences) through the implementation of mitigating measures. EIA assesses the socio-economic as well as human health situations in the communities affected as a result of the project implementation.

The first RA law[11] on the Environmental Impact Assessment and Expertise was first passed by the Armenian National Assembly in 2014. It provides the legal basis for the implementation of state expertise and presents the following provisions for the environmental impact assessment: notification, documentation, public consultations, appeal procedures, requirements, and a few others.

The law provides the type, scale, and location of the activities to be carried out for EIA and their possible monetary and total impact. According to the current law, there are three levels of impacts defined: A (substantial impact), B (medium impact), and C (insignificant impact). The impact assessment and expertise processes are defined for each of the aforementioned levels.

The private company proposing the project should hire a company or an expert to conduct the EIA study. During the environmental assessment process, the applicant should consult with the leaders of the affected communities and with the community concerned.

The community's access to the information and their involvement in the decision-making process is regulated by the RA law on Freedom of information, the RA law on Environmental Impact Assessment and Expertise, and by the Aarhus Convention.

According to the current law, the company proposing the project should organize four public consultations during the impact assessment and expertise processes to involve the community in the decision-making process.

1) The **first** public hearing/consultation is organized by the company conducting EIA, on the technical task of the EIA.

[12] RA law on Environmental Impact Assessment and Expertise ***(Approved on 21, 2014) -*** *https://www.arlis.am/DocumentView.aspx?DocID=93148* .

2) The **second** public hearing/consultation is organized by the RA Ministry of Environment on the EIA technical task.
3) The **third** public hearing/consultation is organized by the company proposing the project throughout the complete EIA preparation period.
4) The **fourth** public hearing/consultation is organized with the mandatory participation of the leaders of the affected communities. During the consultation, The Ministry of Environment presents their conclusions on the EIA.

The place and the time of the public consultations held within the frames of EIA are to be announced in the relevant official daily newspaper ("The Republic of Armenia" daily) at least 7 days in advance. According to the regulatory law, the notifiable documents are to be posted on the official website of the authorized body at least 7 working days before the consultations:

The followings are considered within the frames of EIA:

- Atmospheric air quality
- Surface water and groundwater quantity and quality
- Land use and soil quality
- Geological structure
- Terrain, landscape
- Flora and fauna, forests
- Structures and infrastructures
- Historical and cultural monuments
- Waste volumes and types
- Physical impacts, e.g., noise, vibration, ionizing and non-ionizing radiation
- Probability of emergency situations
- Health, social and demographic factors.

Despite EIA's detailed reference to the sectors, the exact definitions of the laws and involvement of the community in the process, the law has some drawbacks in the provisions of monitoring, control, as well as information collection and submission.

The community involvement has, in fact, a myriad of shortcomings, including the lack of a clear reference to some terms and the absence of guidelines.

Despite the regulatory law, the level of public involvement in the decision-making process in the field of mining remains low. Very few people attend the public consultations, or they do not attend at all. To ensure public participation, the authorized body involves the municipality representatives, but this undermines impartiality.

7. Development — Site Preparation and Construction

Once the mining company has an exploitation permit it can start construction activities needed for implementation of the business plan connected to the permit. The construction could include earthwork, excavation, roads, processing facilities, water and energy facilities, tailing storage facilities, and the like. In some cases, where a mining operation is far from human settlements, housing and other community support facilities must be built as well. (For photo credits see References)

Before mining production, the site has to be prepared by earth grading and building roads.

◄ An example of a mining site being prepared for extraction.

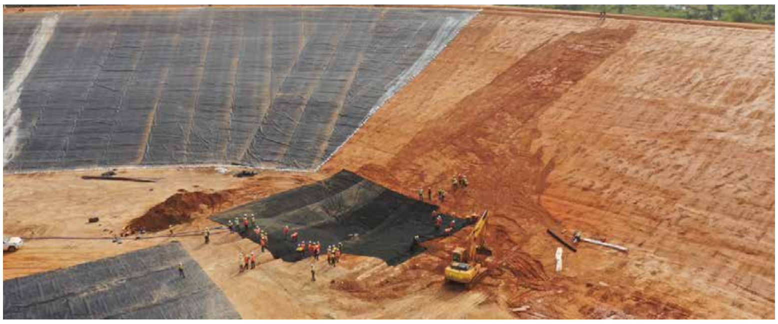
Preparation of the Teghut mininng site in Armenia around 2013. ►

◀ The photo shows a mining operation in Australia that has built its own solar power plant with battery storage capacity.

The processing facilities of the Teghut mine when it was being being built in 2013. The completed facility houses the milling and floatation stages of the copper extraction. ▶

◀ Site preparation work includes the construction of the tailings storage facility (TSF). Here you can see that the TSF has a lining to ensure that the liquids with toxic chemicals do not penetrate into the soil.

Another example of a TSF under construction. It shows the stage where the lining material to protect the soil from polluted liquids is being installed. ▶



8. Production, Risks and Company Obligations

8.1. Valuable Mineral Extraction

As the construction phase comes to completion, the exploitation activities commence and are ramped up to capacity gradually over several months. If it is open-pit mining, then the rock, soil, and ecosystem which lies at the surface is excavated. If it is an underground mine, then the digging of shafts and tunnels begins with excavators. Explosives are also used to fragment rocks.

Once deposits are reached, the ore is extracted, pre-crushed, and conveyed to the processing facility that further crushes, grinds, and through flotation, separates the valuable metals. The concentrate of valuable metals is dried and transported off-site for smelting and refining.

What is left is a mixture of ground rock, chemicals, residual metals, and water. This is called the tailings, which are then sent to a tailings storage facility. The tailings are highly toxic and should be handled with care.

Globally, an increasingly accepted practice is recirculation of water from the processing facilities with a closed-loop water system. Also, there is a trend toward paste or dry stack tailings, where the water content is reduced from 60-70% to 10-20%.

8.2. Waste and TSF Management During Production

Waste collection services are tasked to collect and dispose of different categories of waste from industrial facilities. Some are classified as hazardous wastes.

All wastes should be identified on-site and labelled according to international safety standards and they must be tracked for volumes and composition and have an accompanying safety data sheet. Containers used for offsite transportation must be according to international standards.

Hazardous waste from mining includes:

- Lubricants, spent or expired chemicals and materials they have contaminated, solvents, resins, explosives, gas cylinders, and empty chemical containers
- Contaminated personal protective equipment
- Equipment which has come to the end of their useful life
- Contaminated solids which may be building construction waste
- By-products of processing that may not be easily or economically recycled. The mining and processing of mineral ores result in the production of large quantities of residual wastes that are for the most part earth- or rock-like in nature. These wastes can be subdivided into several categories: overburden (waste rock), tailings, and, in the case of shale-oil extraction, spent shales. (See descriptions of TSF and tailings in the Concepts and Terms section above).

Contaminated waters are usually treated on-site before releasing to the environment and often re-used in the process. It is forbidden to release contaminated water, even in a controlled fashion, into natural waterways. Communities living near mining operations must be vigilant to ensure that treatment of water takes place.

Waste disposal companies are tasked with collection and transportation to a site where the wastes are neutralized chemically or incinerated before disposal. **Disposal** means that the waste solids are in a safe enough form to be buried in a site that is managed and licensed for such activity. They follow strict safety procedures, to include the transportation portion. Containers and packaging of the waste are labelled and identified according to international hazardous waste transportation rules.

In case of a spill during transportation, the appropriate government ministries must be notified immediately so that proper isolation and decontamination procedures are followed.

One of the most hazardous waste types generated by metal mining are the tailings, which are transferred and stored in tailing storage facilities (TSFs). As of 2019, in the Republic of Armenia, there are 23 metal mine TSFs. Each of these have their own unique set of risks to the environment and public safety. Such risks can emerge from tailing storage facilities of all types: idle, insufficiently controlled, abandoned, and closed. Of particular concern are insufficiently controlled and abandoned tailing storage facilities without active monitoring and maintenance.

A TSF in service is a continuously operating structure that is an integral part of mining and mineral processing. Its responsible use, management, and ultimately closure should be a key concern for industry, government, and communities.

Underestimating and neglecting tailing dam safety issues, poor condition of tailing storage facilities dams, and inadequate disaster preparedness lead to irreversible consequences. Since 2000, there have been 54 cases of tailing dam failures/accidents globally with varying degrees of severity.[12] Although for many years the overall number of annual tailings dam failures have declined, the number of serious failures has increased.[13]

Potential pollution associated with tailing storage facilities and a possibility of disasters occurring can persist for a long time. Even those tailing repositories that were built centuries ago are currently regarded as pollution sources and do have the potential to damage the environment. The solution to this problem is tied with proper operation, closure, and maintenance of TSFs.

It is essential to note that the statutory framework for the construction, use, closure, and post-closure maintenance of the TSFs is far from perfect. However, globally, mining companies, engineers, geologists, international organizations, governmental and other organizations have done considerable work aimed at the establishment of construction, operation, and closure principles. Armenia would need to learn from and localize many of these principles.

In this regard, for instance, parties to the Prevention of Major Industrial Accidents Convention,[14] along with

[13] *http://www.wise-uranium.org/mdaf.html*
[14] *http://www.grida.no/publications/383*
[15] *C174 - Prevention of Major Industrial Accidents Convention, 1993 (No. 174): https://www.ilo.or*

several international companies, adopted a decision to develop management principles to reduce risk levels of tailing storage facilities and similar structures. Additionally, a joint group of water and industrial accident specialists established in the Convention's frames, approved the tailing dam and cross-border accident management guidelines.

Knowledge of TSF design, operation, maintenance, and closure is continuously evolving and increasing. See Educational Handbook[15] prepared by the AUA Center for Responsible Mining on some of the lessons learned in the country on this topic. The topics covered include:

- Mine waste and TSFs in Armenia
- Risks and environmental impacts related to mine waste and TSFs
- Factors contributing to TSF dam failure
- Legal and institutional framework on mine waste and TSF safety in Armenia
- Management of disasters related to TSFs in Armenia

8.3. Production -- Risks and, and Social, Environmental, Disaster Preparedness, Public Health, Occupational Health and Safety, Production and Financial Obligations

During the life of the mine, the mining company should fulfil many obligations including financial, social, environmental, and health and safety obligations. Table 1 outlines some of the specific risks and impacts that emerge from poor environmental, health, social, and safety practices.

Table 1. Impacts and Sources of Risks from Mining

IMPACT	SOURCE OR REASON
1. Inefficient use of natural resources	
• Incomplete recovery of ore reserves in mine or deposit • Poor recovery of metals/minerals in the beneficiation process • Overconsumption of water and energy	Poor mine plans Inferior beneficiation methods and/or poor optimization of processes Poor management and work routines
2. Effects on landscape and morphology	
• Visual and aesthetic effects; change in landform • Land use in competition with other utilization Destruction of natural habitat • Land subsidence	Excavation of open-pit mines Establishment of industrial areas for ore dressing Design of tailings dams and waste rock dumps

[16] *Movsisyan, H., Karapetyan, K., Hovhannisyan, H., authors; Matevosyan, H., Arakelyan, A., editors. Mine Waste and Tailing Storage Facilities in Armenia: Disaster Risk Management. AUA Center for Responsible Mining, American University of Armenia, Yerevan (2020) https://crm.aua.am/files/2020/02/ALTER-Handbook.pdf*

IMPACT	SOURCE OR REASON
• Land/soil erosion; changes in river regime due to siltation and flow modification • Abandoned equipment, plants, buildings, excavations	
3. Water use and/or pollution	
• Overexploitation of groundwater sources • Withdrawal of water in competition with other utilization • Contamination of surface water used for drinking, irrigation, aquaculture, recreation Suspended solids in drainage • Contamination of groundwater wells and springs	Excessive use of process water Discharge of contaminated water from tailings dams or directly from plants Acid mine drainage (AMD) from mines AMD from tailings and waste rock disposals Contamination by reagents used in mineral processing
4. Air pollution	
• Spread of fine mineral dust (particulate matter 2.5 (PM2.5) and 10 (PM10) micrometers, PM10 and) • Acidification of water bodies and soil from smelter gases • Contamination from air transported particles, metallic compounds and gases	Dusting from dry tailings deposits, other mining waste and open pits SO_2 emissions from smelters Emissions of lead, arsenic, and other substances through smelter gases
5. Soil pollution	
• Contamination of agricultural soil, • Contamination of ground in inhabited areas	Transport of metals and other substances related to mining operations by air (e.g. smelters and dusting from tailings deposits) or water (e.g. runoff from tailings deposits)
6. Effects on flora and fauna	
• Destruction of natural habitat • Destruction of adjacent habitat • Disturbance of wildlife • Impacts on aquatic life, flora and micro fauna	Deforestation related to operations or the activity of intruding settlers
7. Environmental emergencies	
• Catastrophic failures of tailings dams • Accidental spillage of toxic substances	Deficient design or management of tailings or other waste disposal structures The use of unsafe exploitation methods Poor facilities for storage and transport of toxics

IMPACT	SOURCE OR REASON
8. Noise and vibration	
• Effects on human health • Damage to buildings	Mine blasting Operation of vehicles and other heavy equipment
9. General issues in industrial establishments	
• Fuel spillages • Organic compounds • Uncontrolled spread of sewage	Vehicle servicing Leaking transformers Deficient materials handling
10. Socioeconomic impacts	
• Impact on local population's physical and economic living conditions • Impact on local culture and social organization • Social turmoil due to influx of settlers (boom conditions)	Vehicle servicing Leaking transformers Deficient materials handling
11. Occupation health and safety	
• Exposure to toxic materials (cyanide, mercury, other toxic material) via inhalation, ingestion, or dermal contact • Silicosis • Exposure to heat, noise, vibration • Physical injuries due to accidents • Death	Fugitive emissions within the plant Handling of chemicals, residues, and products Explosives handling Lack of adequate equipment, sound routines, and satisfactory safety management Unsanitary living conditions

A 2018 World Bank document and platform called the Environmental Social Framework (ESF) summarizes the best policies and standards that also facilitate funding of mining-initiated projects. The guide is tuned on practicing transparency, non-discrimination, public participation, and accountability. Key items are discussed in the sections which follow and are considered as company obligations. These discussions are initiated with all stakeholders upon presentation of a new project or significant expansion of an existing facility and developed further during impact assessment studies. They involve social, environmental, health and safety, production planning, and finance obligations

Social Obligations

Under social obligations, there are 3 expectations placed on companies:

1) Local content provision
2) Community consultation requirement
3) Infrastructure requirement

The first of these is with regards to hiring staff locally as much as possible. If possible hiring local contractors and sourcing local supplies as much as possible.

The second is the requirement to hold consultations with local communities about their operations. Often these are imposed by laws, contracts, and by financial institutions. The companies must then submit reports periodically on social impacts following the consultations.

The last item is the requirement to build and operate infrastructure such as hospitals, clinics, schools, or roads in and around operations to attenuate the effects of the operational impact, facilitate social acceptance, and ultimately improve the quality of life of communities. Company updates on their website may be helpful to track progress and obtain updates on company commitments and public consultations. An additional means of obtaining updates and tracking progress is through visual verification of the construction and opening of new community facilities. The annual company Corporate Social Responsibility (CSR) report may feature a complete update.

Environmental Obligations

Six of the 11 sets of risks presented in Table 1 are environmental in nature (categories 2-7), all with public health and wellbeing consequences as well. These include:

- Landscapes and morphology
- Water use and quality
- Air pollution
- Soil pollution
- Biodiversity
- Catastrophic environmental consequences in cases of natural disasters

To various degrees, these risks and negative impacts can be present in all phases of mining - exploration, development (construction), full production (extraction, processing, tailing transfer and storage), reclamation, and post-closure maintenance. Figure 5 illustrates the emission and pollution sources of mining operations on air, soil, as well as surface and underground water. It also points out potential sources of acid rock drainage (ARD), which can plague mining operations and their legacies.

To manage these risks, mining operators are required to carry out onsite environmental management consistent with the approved EIA, monitoring and reporting of environmental conditions, and conducting new EIAs when there are project changes or additions. Community members must participate and understand if all the adequate risks are accounted for, and the mitigation measures are satisfactory. They can do this in part through participating in public hearings and requesting information from the government on the performance of the mining operation.

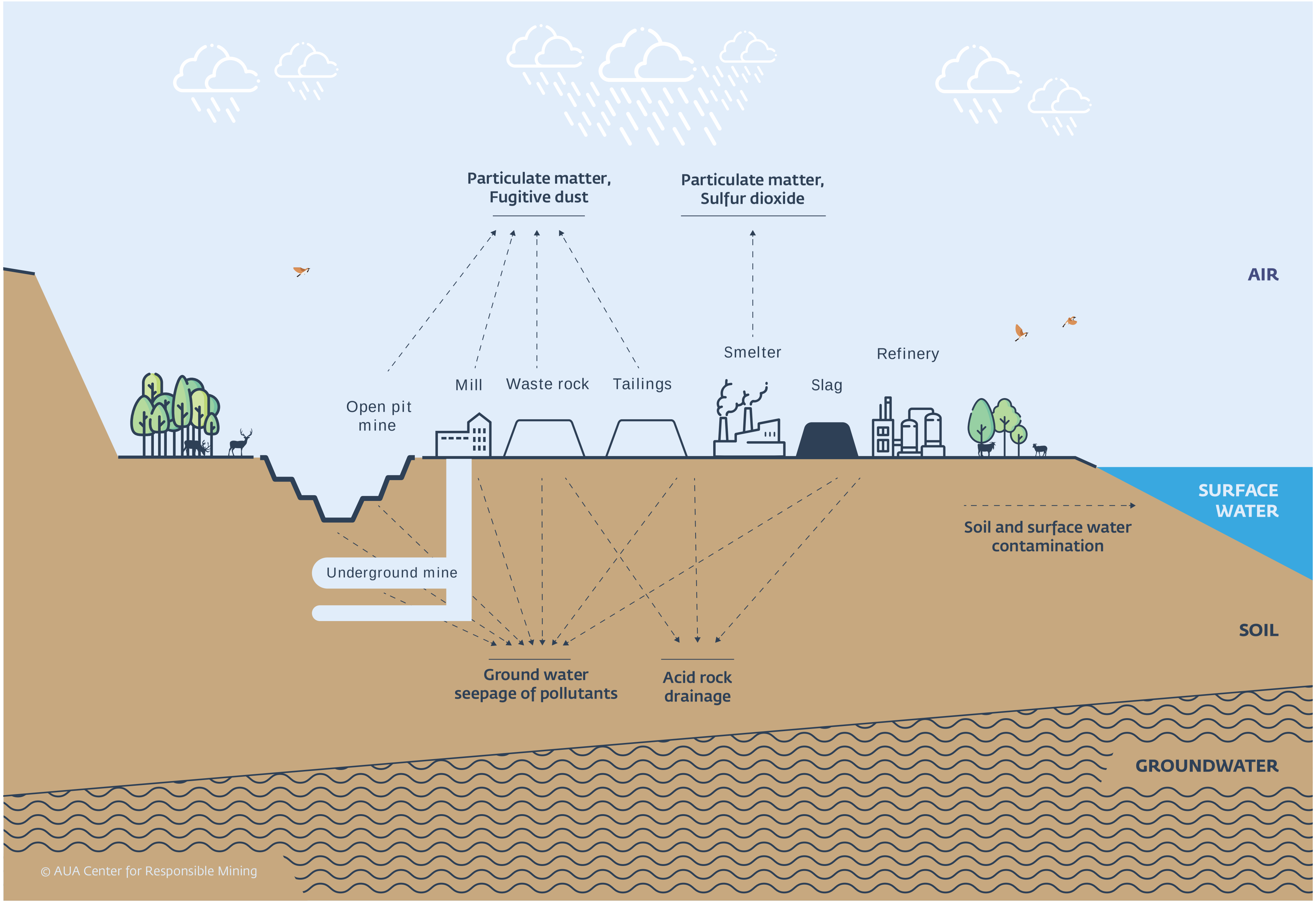


Figure 5. Emissions and pollution from mining operations

An on-site management plan is facilitated by the proper design of a new facility and includes safe storage of bulk and specialty chemicals, gases, as well as containment of in-process minerals. During startup and operation, ongoing reporting and tracking of emissions and spills on-site becomes an ongoing activity. In addition, timely response to any emergency on-site by a trained emergency response team for major events that affect the environment and issuing a detailed report to the ministry must also be done on an ongoing basis. Tracking and thorough identification, packaging, and quantification of hazardous waste shipments and planning for safe disposal of obsolete equipment is another ongoing requirement.

New equipment and new processes must be fully reviewed by a qualified technical team for environmental impact with hazard analysis techniques and upon implementation tracked for safety like all existing processes.

Open discussions to clarify direction takes place with all stakeholders during consultations which may be at the very beginning of a project, during construction, or following major or repeated environmental incidents during operations and mine closure. Often, it is possible to detect issues by observations, for instance, unusual levels of suspended dust, smell, smoke, noise, vibration, or colour changes to soil or riverways are quick indicators. Also, discussion with company workers living within the community can clarify a situation. A company spokesman will usually explain the difficulties encountered and how the problem is being addressed through the media. Information can also be obtained from the ministry and the annual CSR report.

Disaster Preparedness Obligations

Safety and security can never be taken for granted. Disaster preparedness plans, based on credible scenario analysis, need to be incorporated into all existing management policies and processes.

Mining disasters may be operational (e.g. hazards from dam or pipeline failures) or environmental (e.g. natural disasters or ground subsidence). While industry has a responsibility to be prepared for disasters through internal mechanisms, it's equally important to work with communities living near mine sites to increase their understanding of potential threats to safety and security.

These threats can be from direct and indirect exposure to risks or psychological threats caused by fear of the unknown impacts of a potential incident such as a tailings failure. Both real and perceived risks damage social confidence and trust in the industry.

Regrettably, local communities are not always adequately informed of potential risks and are therefore unprepared for emergencies. A fast and effective local response to an incident can be the most important factor in limiting injury to people as well as damage to property and the environment.[17]

Public Health Obligations

Subsoil plots are provided for use if the users comply with the requirements of environmental protection and the protection of human life and health stipulated by the law[18].

---

[17] *https://www.icmm.com/en-gb/health-and-safety/risk-management/emergency-preparedness-response*

[18] *RA Mining Code 1st Chapter 5-th Article*

Payments are made not only for the exploitation of the subsoil but also for monitoring the land of the extracted mineral, the location of the industrial landfill generated by the extraction, as well as the safety and health of neighboring communities.[19]

In case of mismanagement or the absence of management of environmental and social risks incurred by mining the following diseases are likely to spread among the population: skin diseases, respiratory diseases, cancer, to name a few.

Occupational Health and Safety Obligations

Occupational Health and Safety is a serious concern. Worker injuries and illnesses have plagued the mining industry for years. Health and safety policy and a management system are vital to maintaining healthy and engaged employees. This includes administrative employees, visitors, and contractors working on-site. Plans for health and safety management should be well communicated by the company in early consultations with all stakeholders.

Proper health and safety management will include accident and incident reporting with full investigations leading to corrective actions, the use of appropriate protective equipment for each task, and training on how to wear, clean, store, and replace them. In addition, technical teams are also involved in developing safe work instructions and checklists as they have a solid understanding of the fundamentals of processes. Supervisor and operator involvement in developing safe procedures is a very good practice for a safer workplace, it also brings a feeling of ownership to non-technical staff and often speeds up training, implementation, and maintaining a safe workplace. Again, and as for environmental obligations, new equipment and new processes require thorough review for safety with hazard analysis techniques and upon implementation, tracked for safety like all existing processes.

Health and safety is an ongoing effort and the aim is to achieve zero incidents and accidents. If a major accident or repetitive incidents and accidents occur at a facility the company must be open to having public consultations with the presence of the government, the community, NGOs, and Civil Society to clarify and discuss the situation. It is possible to obtain information on the performance of health and safety policies and their management by speaking periodically to workers who reside within the community if the company is slow in communication. In addition to a company spokesman's announcements on media involving incidents and accidents as well as corrective actions, information can be obtained in the annual CSR report.

Production and Financial Obligations

As part of the transparency drive, governments request from companies information on planned new exploration, construction activity, plant capacity, technology changes, budgets, processing and new waste sites planned. The mining company reports to the government once a year on work plans and budgets.

In addition, annual taxes and royalties must be paid and mineral, refined metal, and by-product volumes reported. This information can be accessed on the EITI e-reporting portal.[20]

---

[19] *RA Mining Code 6th Chapter 61st Article 3rd point*

[20] *https://www.eiti.am/en/*

9. Reclamation — Closure and Rehabilitation

According to the RA Mining Code, mines must have a closure plan, which is initially submitted with the application to obtain the license. Mine closure and reclamation should be conducted progressively. As such it must be planned from the early stages of the project. This should be captured in the mine closure plan and updated periodically. Countries are beginning to require such progressive closure and rehabilitation of mine sites to avoid the financial, social, and environmental risks of waiting for decades before a site is fully closed and rehabilitated all at the same time.

Four (4) universal and fundamental closure objectives include:

- Physically stable land
- Chemically stable land
- Environment that is reasonably safe and healthy for humans, wildlife, and the overall ecosystem
- Promote a smooth socio-economic transition from mining to non-mining

Physical stability is the first condition that must be fulfilled for mine closure objectives. Geotechnical stability and erosional stability must be assured under both normal land management conditions and the influence of natural events. The closure design development should consider multiple site-specific risks such as seismic activity.

Chemical stability is necessary to prevent adverse environmental effects and associated impacts on local communities.

Socioeconomic conditions can be managed as physical and chemical stability are achieved. To dampen economic hardship, whenever possible, the skills and/or experience acquired by employees of the mine can be used to create new business opportunities.

Several additional hazards exist on mine sites that need to be removed for the safety of humans and wildlife. These include steep slopes, horizontal and vertical openings to access a mine, unstable ground, mine equipment and supplies, buildings and infrastructure, and more. Access must be prevented to areas that may not be secured from hazards.

Flambeau Mine Site in the United States: a) before mining (1991), b) during mining (1996), and c) after mining (2002)[21 22]

[21] *Fox F.D. Mining and sustainable development Flambeau and Ridgeway mines- lessons learned. 2002. Presented at SME Annual Meeting, 2426 February 2003, Cincinnati, Ohio. http://www.mining.ubc.ca/mlc/presentations_pub/sme/FoxPaper.pdf*

[22] *Reclamation of Degraded Landscapes due to Opencast Mining, N. Kuter, July 1st, 2013. DOI: 10.5772/55796 https://www.intechopen.com/chapters/45415*

10. Post-Closure Management

In most countries (including Armenia), once closure and its documentation are complete, post-closure monitoring and assessment of the closure landscape formally begins. Annual performance inspections are necessary to document the trajectory of the landscape, culminating in the submission of a Performance Assessment Report.[23]

Performance Assessment Reports provide all as-built drawings and documentation for the time period, as well as a detailed, often quantitative, summary of actual conditions on-site in comparison to target performance. Additional reclamation and closure work may be necessary where targets are not achieved, and residual risk is identified.

It should be noted that post-closure monitoring and management has many aspects including social, economic, and environmental ones. For instance, the communities that relied on mining jobs must make the transition to a different economy. Also, the reclaimed sites may pose environmental or public health hazards if not maintained properly. Communities may decide to repurpose the closed and rehabilitated sites for other uses. These uses will have to be consistent with health and safety requirements. For an extensive discussion of closure and post-closure issues of mining sites visit a recent (2021) publication by the World Bank called Mine Closure: A Toolbox for Governments.[24]

[23] *Articles 49; 50; 51, RA Code on Mineral Resources, ՀՕ-280-Ն, 28-Nov-2011 https://www.arlis.am/documentview.aspx?docid=126310*

[24] *World Bank. 2021. Mine Closure: A Toolbox for Governments. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/35504*

11. Legacy Mines and Tailings

Legacy, also known as abandoned mines and mine sites, can be found throughout the World and the situation is very much the same in Armenia.

These sites can be visually recognized and look like man-made lakes, horizontal dugouts, vertical pits, and excavated areas. Many have high walls and indicate signs of landslides that can collapse again. The old tailings sites can have fragile walls and display seepage at the foot of the walls with extensive signs of the tell-tale orange colour indicating acid mine drainage. Dangers can be even greater in springtime as the ice and snow melts at higher altitude and releases water which collects in these old tailings areas. The government of Armenia manages these zones. Current methods of returning waste sites to nature rely on covering them with thick layers of earth and other minerals which is very expensive and only affordable for very few companies or governments. In addition, the site is subject to constant monitoring for decades. The industry is promoting and funding research to develop novel, resilient, and less costly methods to deal with the challenges of old sites. Re-treatment of mine waste programs has been initiated in some countries with only a handful of successful projects to date. In these cases, the rejected material stabilizing for return to nature can be factored into the project cost. The treatment of seeping surface waters from tailings ponds and waste rock is also very expensive and requires continuous dosing of neutralizing chemicals.

Many hazards exist around these sites, and they should not be approached for any reason. Within tunnels and pits there is a chance of collapse and acidified surface waters releasing toxic gases as well as radioactivity. Abandoned storage tank zones, old equipment, and buildings should also never be entered as dangers exist within such as leaky containers of chemicals and exposed explosives.

In addition, exposed pipelines are sometimes seen on roadsides, these may be damaged and be releasing streams of acidified water. Again, the presence of acid mine drainage can be visually recognized.

Naturally occurring hazards may also exist in areas that may seem to be distant from mining and quarrying activity. These are usually detected in the quality of the well waters. The geochemical background concentration will indicate a higher level of dissolved contaminants. These waters may be unsuitable for human use or consumption.

Abandoned Kavart mine located in Syunik Region of Armenia with clear signs of Acid Rock Drainage (Photo: AUA Center for Responsible Mining)

12. Suppliers and Experts of the Mining Industry

The mining industry is a large purchaser of equipment, supplies, and expertise (some of which, in many countries, must be licensed). Mining companies source all these internationally and locally, depending on availability. The more local sourcing there is, the bigger the positive economic impact on the region and the country.

Suppliers to the mining and quarrying industry distribute services, equipment, chemicals, non-renewable and renewable resources.

Examples of large equipment are often large mechanical excavators, trucks and processing vessels, pumps, and piping. These are not all made locally and are ordered from foreign countries. Smaller equipment may include spare parts for the larger equipment as well as electrical instrumentation.

Chemicals used in mining and processing minerals contaminate the land, water, and air, causing health problems for workers and people living near mines. Toxic chemicals used in mining include:

- Cyanide, sulfuric acid, and solvents for separating minerals from ore
- Nitric acid
- Ammonium nitrate and fuel oil used in blasting tunnels
- Gasoline, diesel fuel, and the like

Natural non-renewable resources are mainly materials that cannot be renewed or recycled easily such as chemicals, natural gas, and industrial gases. The term may also refer to how power is generated and delivered to the site. If fossil fuels are used to create electricity, then the power is non-renewable.

Renewable resources are easily renewed within a short period such as water, forests, and plants. The main renewable resource in the mining industry is water. Some materials such as metals and plastics can be recycled several times for re-use, and these are also termed renewable, but this is often complicated to carry out as equipment has to be decontaminated and easy to dismantle. It is true that the more it is possible to recycle the less mining will be required.

Mining companies are often the main employers in the communities of their operations. As the salaries in the mining industry are relatively high, the companies offer careers for high-level professionals throughout the country, including geologists, hydrogeologists, surveyors, consulting/design engineers, mining engineers, economists, lawyers, chemists, explosives experts, heavy equipment operators and maintenance experts, sampling specialists, environmental researchers and specialists, public health and medical professionals, educational and academic institutions, and more.

13. Future Sustainable Technologies for Mining and Quarrying

The main developments in the mining industry in the coming years are technologies that use **reduced amounts of water in processing** coupled with dry storing of wastes, as well as automated and intelligent mechanized equipment so that a man can operate from a safe distance. Additional developments include: **fully electric vehicles** for the transport of ore, **power supply from renewable systems**, reduced reliance on surface truck transport, and increased use of conveyor systems for crushed ore handling.

Other developments are likely to include new fragmentation techniques to **move away from explosives** and the ongoing effort to **develop less toxic lixiviants** for dissolving gold, copper, and other metals from concentrates, and ores which can also be reconstituted easily for re-use in a closed cycle.

These all lead to reducing the footprint of mining and reducing the costs to return the site back to nature. These also decrease reliance on fossil fuels and increase worker safety. Economic composition or metal content in easier to mine ore is diminishing and more rock may need to be excavated, thus these technologies become vital to support the future of the industry as well as for social acceptance.

Mineworkers will need to learn new skills and become familiar with automated interfaces. Trends to **no labor** (fully automated) mining, though not imminent in Armenia, are actively discussed in many developed countries, some having set targets for fully automated mines.

Another trend to track is **deep-sea mining**. It is a growing subfield of experimental seabed mining that involves the retrieval of minerals and deposits from the ocean floor found at depths of 200 meters or greater.[25] [26] As of 2021, most marine mining efforts are limited to shallow coastal waters only, where sand, tin, and diamonds are more readily accessible.

There are three types of deep-sea mining that have generated great interest: polymetallic nodule mining, polymetallic sulphide mining, and the mining of cobalt-rich ferromanganese crusts. [27] The majority of proposed deep-sea mining sites are at 1,400 to 3,700 metres below the ocean's surface.[28] At these levels massive ore deposits, containing silver, gold, copper, manganese, cobalt, and zinc, can be found.[29] [30]The deposits are mined using either hydraulic pumps or bucket systems that take ore to the surface to be processed. To achieve such an engineering feat, however, technological advances are needed. Equally important will be the environmental standards that have to be developed and enforced.

---

25 *Seabed Mining. The Ocean Foundation. 2010-08-07.*
26 *https://dsm.gsd.spc.int/index.php/publications-and-reports*
27 *https://www.isa.org.jm/index.php/exploration-contracts*
28 *Ahnert, A.; Borowski, C. (2000). "Environmental risk assessment of anthropogenic activity in the deep-sea". Journal of Aquatic Ecosystem Stress and Recovery. 7 (4): 299–315. doi:10.1023/A:1009963912171*
29 *Halfar, J.; Fujita, R. M. (2007). "ECOLOGY: Danger of Deep-Sea Mining". Science. 316 (5827): 987. doi:10.1126/science.1138289*
30 *Glasby, G. P. (2000). "ECONOMIC GEOLOGY: Lessons Learned from Deep-Sea Mining". Science. 289 (5479): 551–3. doi:10.1126/science.289.5479.551*

Annexes

Annex 1.
Environmental, Social, and Health Monitoring Checklist
(Version October 30, 2021)

Date				
Name (Company):				
Community, Marz:				
Name of extractable resource				
Number of employees:				
	Women		Men	

Monitoring has been conducted by:	N.S.	
Questions have been answered by:	N.S.	
	Occupation	
	Phone #	

#	Category	Subcategory	Y	N	N/A	Comments
1.1	EIA & Environmental permits (LUP, WP, etc.), certifications, and other related documents.	EIA reports have been approved by stakeholders.				*EIA report accessible online, if so, mention the address of the website.*
1.2		Environmental permits obtained from the appropriate regulatory authorities of the government.				*Expiry date of the permission.*
1.3		Other local or international certificates.				*Expiry date of the permission.*
1.4		Last inspections from the EPMIB in the previous three years				*Have these resulted in any penalties, fines, major recommendations, or corrective action plans?* *(Date of visit)*
2.1	Labor and Working Conditions	The mining and quarrying company received inspections from HLIB in the previous three years.				*Have these resulted in any penalties, fines, major recommendations, or corrective action plans?* *(Date of visit)*
2.2		All employees have employment contracts.				*The number of the contracts.*
3.1	Resource Efficiency and Pollution Prevention and Control	Air pollutants, such as sulfur oxides (SOx), nitrogen oxides (NOx), soot, and dust emitted from the vehicles and the facilities comply with the emission standards.				*Which kind of mitigation measurements have been taken?*

(Version October 30, 2021)

#	Category	Subcategory	Y	N	N/A	Comments
3.2		Mitigation activities were taken to prevent fugitive dust emissions from the dry surfaces of tailings facilities, waste dumps, stockpiles, and other exposed areas.				
3.3		Water Usage.				*The quantity of water usage doesn't surpass the allowable limit.*
3.4		Water Quality in and around mine sites are fitting with water quality standards of RA.				*The quality of surface and groundwater does not cross the range of MAC of water quality parameters.*
3.5		Wastes (including hazardous wastes and other industrial wastes).				*Generated waste properly treated and disposed of in accordance with the regulation law of RA.*
3.6		Soil quality				*Measurements have been taken to prevent soil contamination.*
4.1	Health, Safety, and Security	Noise and vibration levels at the site and proximity to sensitive receptors such as schools, and housing does not cross the allowable limit.				
4.2		PPE available, replaced at no cost (cap, puncture-proof sole boot, earmuffs and plugs, goggles, elastomer nose/mouth cover and replaceable filters, etc.).				
4.3		Physical injuries due to accidents.				

(Version October 30, 2021)

#	Category	Subcategory	Y	N	N/A	Comments
4.4		Deaths among workers in the mining area.				
5.1	Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Land Acquisition Act				
5.2		Restrictions on Land Use				
5.3		Involuntary Resettlement				
6.1	Biodiversity Conservation and Sustainable Management of Living Natural Resources	Areas/location of specially protected nature areas of Armenia as part of the mining and quarrying company.				*The type of protected area.*
6.2		Habitat of RB registered species of plants and animals in the mining area.				
7	Cultural Heritage	The company obtained the necessary permits/ approvals for its operations.				*Information presented in the EIA report.*
8.1	Information Disclosure and Stakeholder Engagement	Affected Communities engaged through the process of stakeholder engagement.				
8.2		Affected Communities have access to relevant information (the purpose, nature, and scale of the project; duration of proposed project activities; relevant mitigation. measures; grievance mechanism).				*If one point from provided information is missing, then mention "NO".*

(Version October 30, 2021)

References for Annex 1

#	Links	Name of the legal act	Adopted by	Date of adoption	Decision No
1	https://www.arlis.am/documentview.aspx?docid=91594	On Environmental Impact Assessment	RA National Assembly	June 2014	AL-21
2	https://www.arlis.am/documentview.aspx?docID=71305	National Air Quality Policy: The 1994 Law on Atmospheric Air Protection (several times amended), National Ambient air quality standards.	Supreme Council, RA National Assembly, Government Resolution	October 1994, September 2011, 2006.	HO-121 HO-249-N
3	https://www.arlis.am/DocumentView.aspx?docid=10767	On approving the water abstraction quantities from water resources and the order for approving the water abstraction regime.	RA Government	March 2003	354-N
4	https://www.arlis.am/DocumentView.aspx?docid=71621	RA Water Code (Integrated river basin management, Distribution of waters based on supply, and not demand Provision of water use permits based on information, Use of economic instruments in management and cost-recovery of water resources).	RA National Assembly	4 June 2002	HO-373-N
5	https://www.arlis.am/documentview.aspx?docID=65705	On Defining Water Quality Norms for Each Water Basin Management Area taking into Consideration the Peculiarities of the Locality.	RA Government	January 2011	75-H
6	https://www.arlis.am/DocumentView.aspx?docid=18723	Sanitary Norms on Noise in Workplaces, Apartment and Public Buildings, Territories of Urban Construction.	Ministry of Health	March. 2002	N138

#	Links	Name of the legal act	Adopted by	Date of adoption	Decision No
7	am/DocumentView.aspx?docID=29624	On Specially Protected Nature Areas	RA National Assembly	November 2006	
8	http://extwprlegs1.fao.org/docs/pdf/arm159335E.pdf	The Red Book on Plants of the RA	RA Government	January 2010	72-N
9	http://extwprlegs1.fao.org/docs/pdf/arm159333E.pdf	The Red Book on Animals of the RA	RA Government	January 2011	72-N
10	https://www.arlis.am/documentview.aspx?docID=114273	The RA Law on Waste	RA Government	January 2017	689-N

Additional sources

Link	Name of the Document	Organization
https://www.ebrd.com/downloads/policies/environmental/mining/mining-open.pdf	Sub-sectoral Environmental and Social Guidelines: Mining Open Cast	EBRD
http://toolkit.cdcgroup.com/reference-materials/cdc_environmental_and_social_checklist_-_final_-_150622/	CDC ESG toolkit	CDC Investment Works
https://www.banktrack.org/download/160802_e_s_checklist_mining_pdf/160802_es_checklist_mining.pdf	Environmental and Social Checklist (Mining)	Mizuho Bank, based on IFC PS's
https://resourcegovernance.org/sites/default/files/RWI_Enforcing_Rules_full.pdf	Government and Citizen Oversight of Mining: Enforcing the Rules	Revenue Watch Institute
http://212.42.195.34:92/index.php/water-legislations/main-legislative-acts-of-the-water-sector-in-armenia/?lang=en	Main Legislative Acts of the Water Sector in Armenia	ECO Portal, Statistical Committee, MOE

Annex 2.
Details on Mining Activities, Impacts, and Mitigations

Table 1. Physical impact of exploration activities

ACTIVITY	IMPACT	DURATION	MITIGATION
Road Access	Human footprint and traffic pollution	Permanent	
Trenching	Soil Erosion	Short term	Revegetate
	Land Scars		as above
	Risk of falling		fill
Drilling	Noise and vibration	Short term	
	Land clearing		Revegetate
	Contaminated soil and water		Cover and re-vegetate

Table 2. Physical impact mining Open Pit or Quarrying

ACTIVITY	IMPACT	DURATION	MITIGATION
Vegetation Removal			rehabilitate
Soil Erosion			revegetate
Watercourse Diversion			
Sediment Loading Waterways			
Mine Machinery Noise	Trucks, excavators, primary crushers	Long term	noise measurements
Blasting Noise and Vibration	Periodic	daily	noise and vibration measure
Overburden and Waste rock	Visual and land loss	Long term	rehabilitate
Explosives Handling	Worker health and safety	Daily	safe procedures
	Nitrogen oxide gases		
Water Accumulation, Precipitation, and Aquifer	Acid mine drainage		deviate and treat before discharge to nature
Airborne Dust	From blasting and trucks, excavators		air sampling program, dust suppression techniques

ACTIVITY	IMPACT	DURATION	MITIGATION
Excavator and Truck Waste	Fuel and lubricant leaks		
Land Subsidence	Landscape alteration		

Table 3. Physical impact of mining shallow and deep underground

ACTIVITY	IMPACT	DURATION	MITIGATION
Seismic	Collapse over works	At any time	Fill at end of life
Unstable Ground	Collapse over works	At any time	Fill at end of life
Water Accumulation	Acid Mine Drainage		
	Land subsidence		

Table 4. Physical impact of concentrator, smelter and refinery - cement processing

ACTIVITY	IMPACT	DURATION	MITIGATION
Gases Emitted	Toxic gases to atmosphere (SO_2, CO, NO_2, Cl_2)		Gas capture in ventilation systems and/or valorization into by-product
Dust Emitted	Toxic particulates dispersed to atmosphere		Dust collector in ventilation systems dust re-processing for metal values and safe disposal
Noise	Machinery and process		Distance the location of facility from communities
Wet Tailings	Refer to table 6		
Waste Slag	Slag heaps, leachate becomes toxic, dust blown to environment		Lined impoundment zone, program for processing and valorization

ACTIVITY	IMPACT	DURATION	MITIGATION
Used Machine Parts, Supplies	Corroding equipment, leaking lubricant and fuel, used PPE	Ongoing	Waste Disposal program - offsite regulated company
	Process spill, toxic and corrosive liquids or solids		Concrete containment
	Chemical spills from tank farm		Concrete Containment

Table 5. Physical impact of heap leaching

ACTIVITY	IMPACT	DURATION	MITIGATION
	Land loss	During	Rehabilitation
Heap Leaching	Seepage = Acid mine drainage, toxicity to environment Bottom of heap	During, end of life,	Geotextile liner to retain lixiviant
	Lixiviant spray dispersed by prevailing winds	During and end of mine life, following heavy rainfall or spring thaw	Disaster planning, preparedness, lagoons as retention basins. Safest dam wall construction type
	Dust blown into environment and communities	During and end of life,	Revegetate
	Inaccessible to population and fauna	During mine life	Rehabilitate
	Toxic to fauna and flora	During life of mine	
	Waste rock	permanent	Rehabilitate

Table 6. Physical impact of tailings dam

ACTIVITY	IMPACT	DURATION	MITIGATION
	Land loss	During	Rehabilitation
	Seepage = Acid mine drainage, toxicity to environment Through dam wall Through dam floor	During, end of life, following heavy rainfall or spring thaw	Constant monitoring, preparedness, wetlands, lagoons for retention, treatment Liner to minimize
	Dam Collapse = Catastrophic flood and environment	During and end of mine life, following heavy rainfall or spring thaw	Disaster planning, preparedness, lagoons as retention basins. Safest dam wall construction type
	Dust blown into environment and communities	During and end of life, worse during drought	Location vis a vis prevailing winds
	Inaccessible to population and fauna	During mine life	Rehabilitate
	Toxic to fauna and flora	During life of mine	
Climate Change	Severity of hazards increased		

Table 7. Physical impact common to all exploitation activities

ACTIVITY	IMPACT	DURATION	MITIGATION
Energy Consumption	Power draw from grid significant, requirement for new power station	Life of mine	Power can be sold to other industries and communities at end of life
Water Usage	Water flow to community affected	Continuous, during operation of concentrator and secondary operations	Use technologies requiring the least amounts of water, recycle and retreat.

ACTIVITY	IMPACT	DURATION	MITIGATION
Influx Workers	Requirement for increased infrastructure, sewage	Life of mine	Hire locally as much as possible
End of Life of Operation - Social	Community loses sole major employer	End of life of operation, mine, concentrator, smelter, refinery	?
Climate Change	Severity of releases to environment increases	Permanent	Environmental Impact studies, continuous consultations during operation
Loss of Cultural Heritage		Permanent	Public consultations
Truck Traffic	Increased heavy truck traffic affects communities, environment		Alternate access and new roads to mine site by-pass communities
Storm-Runoff	Contaminated waters dispersed faster to adjacent land, waterways and communities	Ongoing	Environmental impact studies and public consultations to minimize risks
Abandoned Equipment, Sites, Storage Areas	Hazardous areas to populations and wildlife	Ongoing	Fenced off with warning signs until clean-up possible.
			Decontaminate and repurpose
Biodiversity Change	Ecological change	Permanent	Re-planting programs, protected zones for biodiversity to prosper

Annex 3.
References related to the Environmental, Social and Health Aspects of Mining Sector

#	Document	Links	Organization
1	Environmental, Social, and Governance Toolkits	https://www.fmo.nl/esg-toolkit	Dutch Entrepreneurial Development Bank(FMO)
2	Environmental, Social, Governance (ESG) Toolkit	https://toolkit.cdcgroup.com/about-this-toolkit/	Commonwealth Development Corporation (CDC)
3	IFC Performance Standards	https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards	International Finance Corporation (IFC)
4	WHO Ambient Air Quality Guidelines, General EHS Guidelines: Table 1.1.1	-	
5	Sub-Sectoral Environmental and Social Guidelines: Mining Open Cast	https://www.ebrd.com/downloads/policies/environmental/mining/mining-open.pdf	European Bank for Reconstruction and Development (EBRD)
6	Environmental and Social Policy	-	
7	Environmental and Social Checklist (Mining)	https://www.banktrack.org/download/160802_e_s_checklist_mining_pdf/160802_es_checklist_mining.pdf	Mizuho Bank, based on IFC Performance standards

#	Document	Links	Organization
8	Environmental, Health, and Safety Guidelines	https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines/ehsguidelines	World Bank (WB)
9	The International Comparative Legal Guide.	https://dialog.am/storage/files/posts/posts_06440179831_ML18_Chapter-3_Armenia.pdf	Global legal group (GLG), Concern Dialog law firm
10	Civil Society Monitoring Toolkit	https://resourcegovernance.org/sites/default/files/RWI_Enforcing_Rules_App1.pdf?fbclid=IwAR1-94sDG9UEcGoqdo2QH6XJACMXtwjYNAEOr4Tl24OJW2j7iQQ9g_Z3BIA	Natural Resource Governance Institute
11	Measurement of Environmental and Social Impacts	https://resourcegovernance.org/topics/measurement-of-environmental-and-social-impacts	Natural Resource Governance Institute
12	Description of the Mining Sector of Armenia	https://www.eiti.am/en/	Extractive Industries Transparency Initiative (EITI)

Annex 4.
Related RA Laws and State Organizations for EHS regulations

The main regulating legal act of the mining sector is Mining Code of RA, 2011[31].

See other mining-related legal acts at https://mininginfo.am/ .

According to the environmental regulation and supervision of the mineral sector, three areas of activities are of importance:

- review of EIA for mineral projects,
- environmental inspections,
- regional environmental monitoring.

The mining industry is regulated by the below-mentioned state bodies:

- **Ministry of Territorial Management and Infrastructures**, which develops state policies in the mining sector and ensures compliance with these policies, grants the right of subsoil use, and so on.
- **Ministry of Environment**, which participates in the development of state policies in the sector of environmental protection, implements the limitations determined under the environmental protection laws in the sector of environmental protection, etc. The **"Hydrometeorology and Monitoring Center" SNCO** of MoE regularly samples surface and groundwater and atmospheric air across Armenia and analyses the samples in their own laboratories. The sampling site network includes several locations that are strategically positioned for assessing impacts from mining activities on the natural environment.
- **Environmental protection and mining inspection body**, which implements the state supervision to comply with environmental protection norms within the scope of subsoil use.
- **Ministry of Emergency Situations (MES)** is responsible for the safety expert examination of mining permit applications and they do, as such, have a very important role in being the authority responsible for the assessment of the technical and safety aspects of tailings dams.
- **Ministry of Health**, which processes and implements the policy of the Governments of the RA in the field of healthcare.
- **Health and Labor Inspection Body**: which ensures compliance, in the cases and procedures established by law, with the requirements of legal acts in the healthcare sector, as well as other regulatory legal acts containing the norms of labor legislation and labor law of the Republic of Armenia, collective and labor contracts.

Since joining EITI (2017) and forming the required Multi-Stakeholder Group (MSG), consisting of representatives of Government, Civil Society, and Industry, dialogue among the key stakeholders has developed significantly. Through EITI Reports and its website, a large amount of sectoral information is publicly available.

31 *This replaced both the Mining Code (2002) and the RA Law on Concession of Surveying and Mining for the Purpose of Exploiting Useful Ores (November 5, 2002) and the RA Law on subsoil resources adopted on November 6, 2002.*

References

- Community Development Toolkit, International Council of Mining and Metallurgy, 2012
- Smith E. and P. Rosenblum, "Government and Citizen Oversight of Mining – Enforcing the Rules" Revenue Site Institute, 2011
- Amirkhanian A. "On Mining, Which Way Armenia", Armenian Chamber of Commerce of America, Fall/Winter 2019, pp 28-29
- Cement, Concrete and the Circular Economy, The European Cement Association 2016
- National Research Council Green Mining Initiatives, Canada 2019
- Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development 'Mining Project and Rehabilitation and Closure Guidelines' International Institute for Sustainable Development, Canada, September 2019
- Wyoming Department of Environmental Quality "Dangers of Abandoned Mines", deq.wyoming.gov
- Mine Closure Checklist for Governments, APEC Mining Task Force, February 2018
- Kamunda C., Mathuthu M., Madhuku M. Health risk assessment of heavy metals in soils from Witwatersrand gold mining basin, South Africa // International Journal of Environmental Research and Public Health, v. 13, No. 7, pp. 1–11, 2016
- "Mining in Armenia: an overview", Aram Orbelyan and Lilit Karapetyan, Concern Dialog, 2021
- "On Mining, Which Way Armenia?" A. Amirkhanyan, Centre for responsible Mining, 2018
- The International Comparative Legal Guide to Mining Law, 2018
  https://dialog.am/storage/files/posts/posts_06440179831_ML18_Chapter-3_Armenia.pdf.

crm.aua.am

ISBN 978-9939-1-1426-2