

THE WORLD BANK



Armenia: Strategic Mineral Sector Sustainability Assessment

Swedish Geological AB in association with
SLR Consultants Ltd.
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Acronyms and abbreviations

ARD	Acid Rock Drainage
CSO	Civil Society Organization
DfID	Department for International Development - UK
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EIEC	Environmental Impact Expertise Centre
EITI	Extractive Industries Transparency Initiative
GoA	Government of the Republic of Armenia
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IFC	International Finance Corporation
IGF	The Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development
IISD	International Institute for Sustainable Development
LKAB	Luossavaara-Kiirunavaara AB
LME	London Metals Exchange
MENR	RA Ministry of Energy and Natural Resources
MES	RA Ministry of Emergency Situations
MGA	Mining Granting Agency
MNP	RA Ministry of Nature Protection
MRA	Mineral Resources Agency
NGO	Non-Governmental Organization
NRGI	Natural Resource Governance Institute
OSCE	Organisation for Security and Co-operation in Europe
RGF	Republican Geological Fund
SEI	Stockholm Environmental Institute
SEIS	Sectoral Environmental Impact Study
SME	Small and Medium-sized Enterprise
SMI	State Mining Inspectorate
TSF	Tailings Storage Facility
UNDP	United Nations Development Program
UNEP	United Nations Environment Programme
ZCMC	Zangezur Copper Molybdenum Combine

Executive summary

Introduction

This report provides a review of the Armenian mining sector, and assesses its potential to contribute to sustainable economic growth and development. Based on the findings, it provides recommendations for initiatives and actions for the future development of the sector.

The report was produced in the period October 2015 to April 2016. It was commissioned by the World Bank with the aim to assist the Armenian government to gain a better understanding of key social and environmental challenges and future opportunities for the Armenian Mining Sector; and to support the development of a minerals strategy which is line with international good practices and which contributes to sustainable development.

The findings are based on: desktop reviews of existing documents; a large number of meetings and interviews with affected and interested stakeholders; field work performed in the main mining districts of Armenia; stakeholder workshops. Comments, suggestions and corrections on a draft version of this report has been provided by representatives of the GoA, and the World Bank. Further, oversight and feedback was continuously provided by representatives of the World Bank.

Armenia is a small (29,743 km²), land locked, lower middle income country with a population of about 3 million. The country gained its independence in 1991 and it has a democratic system of governance. It is situated in a geopolitically complex and volatile region, which in turn means that at present, the only significant land based route for trade in and out of the country runs through neighbouring Georgia in the north and to Iran in south. Armenia is a seismically active and mountainous country. There is one major lake, Lake Sevan in the east. Rivers in the west and south drain into the Araks river system and further into Iran and Turkey. In the north and northeast, rivers drain northwards into the Kura river system and further into Georgia and Azerbaijan. The Armenian climate is continental with hot summers and cold winters, and the country is regarded as being especially sensitive to the effects of climate change. The topographic and climatic variations have resulted in highly diverse ecosystems. The forest cover is less than 10% of the country's area.

Armenia's economy has undergone major structural changes since independence, changing from an industry-based economy to increasingly becoming an economy based on agriculture and trade. The minerals sector represents one of few industrial sectors that have developed in an economically positive way, and it is seen by the GoA as having an important role in further development of the country's economy. During the last 14 years, the mining and quarrying sector has contributed 2.2% to overall GDP. The sector has also been able to attract tangible foreign investment, both through the privatisation of state owned enterprises, and through new mineral related developments. In the past 5 years, inflows from exports from the sector have been in the region of USD 500 million annually, making it Armenia's top sector in terms of export and inflow of foreign exchange. Mining companies are significant job providers, especially as they offer formal jobs in more rural areas. In 2014, 7,057 people were employed in the metallic mining sector, which is around 10% of those employed in the industrial branch of the economy.

The current state of the mineral sector

Armenia's geology is generally prospective for minerals projects. With regards to metals, the main metals found include copper and gold, and there are three regions that are especially important, namely: (i) the Lori province in the north with copper deposits of different types; (ii) the Kapan area in the southeast, which hosts copper and polymetallic deposits; and (iii) the Zangezur mountain range in the southwest, where a number of copper and copper-molybdenum deposits are located. Gold is sometimes found in the abovementioned type of polymetallic deposits, as well as in a number of other locations throughout the country.

Metal mining has a long history in Armenia. Copper mining began in the Alaverdi area in the Lori province in the 1770s. In the 1840s, copper mining started in Kapan, and in the middle of the 20th century the larger Kajaran copper-molybdenum mine started production. At present (end 2015), there are 27 granted rights for metal mining; 14 of which are for mines in operation and 13 for projects that are still at the exploration stage. The sector comprises a number of small to medium sized projects and only one large and stably operating mine: ZCMC's Kajaran copper-molybdenum mine that produces some 18.5Mt of ore per year, which in turn represents more than 60% of the turnover of the whole mining sector. Another copper mine that could become a significant producer is the Teghut mine in Lori province, which commenced operation in the end of 2014. Subject to the efficiency of the operation, its copper production could approach half that of Kajaran.

With regards to gold, the Sotk mine in the east is the main producer, and gold is also of major importance at the Shahumyan mine in the south. Reported gold grades at other smaller mines are often high to extremely high, which apparently makes some of these small deposits economic. However, as the reserves tonnages at these mines are small, they generally have corresponding short mine lives. In contrast to the many high grade / low tonnage gold projects, Lydian International's Amulsar project in the south-central area is a low grade / large volume deposit. The project has completed a feasibility study and secured most of the financing needed for mine construction. Lydian plan for a gold production of 200,000 oz/yr for a mine life of 10 years. The value of the yearly production, at current metal prices, would be on par with the value of the production at Kajaran, i.e. 200 million USD.

There are about 440 permits for mining or quarrying of industrial minerals, and the vast majority are for dimension stone, aggregates, or materials otherwise used for construction purposes. Tuff is quarried in western and central Armenia. In the past, tuff sourced from Armenia was used widely as a dimension stone across the Soviet Union. Today, export is difficult, due to both economic, infrastructure and geopolitical reasons. Aggregate quarrying is strongly focussed to the central parts of the country, which is also the primary area of development and urbanization. Basalt and andesite, pumice, and volcanic slag quarrying is likewise concentrated to the area around the capital Yerevan.



Metal mining projects in Armenia.

Despite the relatively large number of quarries, the total production of dimension stone and aggregates is comparatively small in relation to the size of the country. This, in turn, suggests that each operation is small and/or that production methods are inefficient. The production of other types of industrial minerals in Armenia is also overall small and limited to a handful of products. In the past, large amounts of perlite were produced (some 2,200,000 tons in 1990) and Armenia has also in more recent years (since independence) exported perlite to European and neighbouring markets. Today the production of perlite is much smaller but still represents some 2.2% of the world production. Bentonite and diatomite were also mined at larger scales in the past while today the production is much smaller.

There has been little recent greenfield exploration undertaken, and the exploration efforts that exist are usually related to deposits known from Soviet era exploration. There are currently (December 2015) 44 permits for metals exploration. Most of these are located near historic and current mines. The majority of the exploration projects are not at an advanced stage and it is concluded that exploration in Armenia is neither advanced nor very extensive geographically. Considering the fact that Armenia has prospective geology, the number of exploration permits is comparatively small. Furthermore, none of the exploration licenses are held (directly or indirectly) by any of the larger and well known international mining and exploration companies, which in turn suggests there to be relatively little international interest in investing in exploration in Armenia.

There are 21 tailings dams in Armenia, of which 13 are active. ZCMC's Artsvanik dam is by far the largest of the active dams, with a current volume that makes up almost 75% of the total volume of all tailings in the country. The recently commissioned Teghut dam is also designed for large volumes. Other dams are much smaller.

The government is promoting re-processing of tailings, and a specific law has been passed where the control of three specific tailings dams has been handed over to the state for the purpose of contracting out rights for reprocessing. Ideally, there exist possibilities for retreating some of the tailings, and thus addressing both environmental issues and creating economic opportunities. However, international comparison reveals that projects for retreating copper tailings are exceedingly rare. Additionally, the concerns related to the responsibility for the potential environmental impacts need to be resolved.

Regulatory and institutional framework

The Armenian regulatory system has a strong tendency towards extensive regulation by law, rather than by using instruments such as regulation, guidelines or evolved practice. This is an approach that entails frequent revision and amendment of the laws. Thus, the RA Mining Code has been amended comparatively frequently since independence, and additional (although fairly minor) amendments are now before the parliament. Overall in the development of mineral law in Armenia, there appears to have been insufficient focus on policy-making and/or development of concept papers, prior to the legal development process and actual drafting of laws.

The RA Mining Code establishes a regime for the allocation of mineral rights. Exploration rights are awarded on a first-come-first-served basis, while the security of tenure and entitlement of mining rights is less clear. The RA Mining Code applies to all types of hard minerals and rocks, as well as mineral water. All types of mining are regulated in the same way, apart for that landowners are entitled to quarry non-metallic minerals on their own land for their own use. The Armenian Mining Code does not provide for any type of ineligibility cases, and essentially any legal person can apply for a mineral right (although the financial and technical capacity and means of any applicant needs to be approved, and if a mining permit held by a legal person has been terminated, a new mining permit will not be granted to such a person).

The RA Mining Code places strong focus on the role of the State in developing 'State programmes' (policy type documents with limited scope), in mineral sector regulation, and in preparing a State inventory of mineral reserves. The State does, however, not have a role as an entrepreneur, neither in legislation nor in practice. Overall, the Code has similarities with the sub-soil laws of many other transition countries, for example as it encourages increased knowledge of minerals reserves and focuses on the setting of rules for enterprises to carry out the production of minerals from identified ore deposits. Land relations for mining are subject to provisions of the RA Land Code and the RA Civil Code. Land belongs to either the State, communities or is private property. The law provides for a clear process to assign and access land for mining with negotiations between companies and landowners, and governmental decisions around expropriation and compensation in cases of mining projects of paramount public interest. The process however lacks modern concepts to protect landowners and land users rights in relation to compensation and resettlement.

Environmental and social regulation of the mineral sector is primarily based on the RA Law on Environmental Impact Assessment and Expert Examination, 2014 and the RA Mining Code, 2012. The former is sophisticated and includes most modern concepts to anticipate, prevent and mitigate negative impacts on the environment and humans, during the life of the mine and including mine closure. There is, however, a general lack of secondary legislation and/or guidelines to aid implementation of the law (which is partly due to the fact that the EIA Law itself was enacted recently).

Mine waste management is regulated through the RA Mining Code and the RA Law on Waste (most recently amended in 2015) while none of these include provisions that are sufficient for adequate management and control. There are, for example, a lack of clarity in respect of how to determine whether a mining waste is hazardous or not. According to the RA Mining Code, non-operational tailings dams with a proven mineral reserve are classified as "man-made mines" rather than mine waste. These de-

posits are the exclusive property of RA and may be granted for extraction of minerals.

The right for the public to participate in environmental decision making and to access data is protected in a number of ways by the RA Constitution, the Law of the Republic of Armenia on Freedom of Information, the RA EIA law, and the Aarhus Convention ratified by Armenia in 2001. Notwithstanding legal guarantees to ensure access to information, the implementation of the law providing for public participation and data access faces many obstacles in practice resulting in, for example, that data and information are released late or not at all by authorities.

The Ministry of Energy and Mineral Resources (MENR) is responsible for essentially all aspects of mineral sector administration and regulation, and mineral sector policy development. Key departments and tasks include: Mining Department – policy and legal development; Mining Granting Agency – managing and administrating the mineral permit applications; Mineral Resources Agency – reviewing and approval of mineral reserves estimations, required for mining permit applications; State Mining Inspectorate – mine inspections against contractual obligation, with focus on production rates and reserves; Republican Geological Fund – repository for geological data and information, company reports, exploration and mining contracts, and reserves data (from which national balance sheets are established). There is no institution holding geological survey type functions and it is questionable how efficiently the strong focus and significant human resources directed towards reserves verifications and inspections help to develop a sustainable mineral sector.

Within the Ministry for Nature Protection, relevant institutions include: the Environmental Impact Expertise Centre - performs expert examination of EIA submitted with exploration and mining applications; the State Environmental Inspectorate – controls the environmental performance of all industry, and; the Environmental Impact Monitoring Centre - regularly samples water, air and sediment across Armenia to assess the state of the environment. Overall, a key issue at the MNP seem to be insufficient human and technical capacity. Thus, the implementation of the new EIA Law is likely to be challenging. Finally, the Ministry of Emergency Situations (MES) is responsible for the safety expert examination of mining permit applications and, as such, they have an important role in assessing the technical and safety aspects of tailings dams. It appears, however, as if the required knowledge level with regards to tailings dam construction and management does not exist.

Since 2012 (with the new mining code), the Mining Granting Agency (ref above) functions as what is commonly referred to as a “one-stop-shop”, and environmental, reserves and safety expert examinations are performed by different authorities. Interviewed officers at the MENR commonly perceive what they regard as a high number of public hearings to be time consuming and negating an efficient process. On the other hand, officers at the MNP perceive the “one-stop-shop” to prevent direct and meaningful interaction with the applicants.

Armenia has committed to implementing the EITI standard, and a candidature application is being prepared. From this follows that it is the Government’s strategy to move towards accountability and transparency with regards to tax payments, and information on permits, contracts, and production, etc. and towards multi stakeholder participation in driving this strategy forward.

Sustainability assessment

A sustainable minerals sector is one which is in line with all three aspects of sustainability (environment, social and economic). Environmental impacts should be well managed, and operations should not represent a significant risk to surrounding communities and/or land uses in terms of accidental spills or geotechnical failures of waste facilities. In terms of social issues, the operations should enjoy overall support by the local populations (a “social license”). Further, the economic performance should be strong and reliable to ensure operational continuity, and the economic benefits accrued should be equitably shared.

The Armenian mining sector is an important contributor to the national economy (as a source for export incomes, foreign direct investments, and for creating relatively high paid work opportunities outside of urban centres), and it is further shown that it is better at providing tax related incomes to the state compared to most other sectors. However, the sector is in terms of production and value created dominated by the ZCMC. There are a small number of mines that may be referred to as medium scale, and numerous operations in both the metals and non-metals sector which are all small, and rather insignificant in terms of their contributions to national welfare. The fact that the Armenian minerals sector is dominated by one single operation, makes it vulnerable to possible external shocks and this threatens the longer term sustainability of the sector.



Views of ZCMC's Kajaran mine and Artsvanik tailings deposit in Syunik, southern Armenia.

Economic data from the last 5 years made available by the MoF suggest that only two, or three, of the existing metal mining operations have been making regular and stable profits (including the dominant operator, ZCMC). The less profitable (or loss making) companies include most of the small companies that hold mining licenses. Mining operations that commonly make losses, cannot be seen to be sustainable from an economic point of view. This finding is made even more significant in the light that the last 7-8 years represent a period of historically high commodity prices. Further, this poor economic performance has been happening at the same time as inadequate resources have been invested in pollution prevention, and environmental management (see below).

The current mining and exploration related activities are to a dominant extent based upon the work performed during Soviet times. There has been little in terms of exploration and new finds in the last few decades. There has been a lengthy period with no geological research and prospecting activities which, in turn, can lead to their eventually being insufficient known resources and reserves to sustain the sector. This in itself threatens the economic sustainability of the sector, but also, given the relative importance of the sector, the Armenian economy as a whole.

Forming linkages with other sectors of the local economy is a way of enhancing economic performance and sustainability. Although linkages and "local content" exist in Armenia, there could be considerable scope for increasing the participation of local and Armenian businesses within the wider mining sector. Importantly, the roles that may be assumed by local entrepreneurs can also include more knowledge based services, such as technical consulting, and services related to geological exploration.

None of the existing metal mining operations can be seen to be environmentally sustainable. The main problems relate to:

- a. The small metal mining companies that are involved in poorly managed "mining/exploration projects", that were discovered during Soviet times, are creating substantial damage to the environment;
- b. there is significant ongoing pollution emanating from existing mines and processing activities, both to air and water;
- c. there is an overall lack of adequate plans and funds to enable reclamation and rehabilitation of mine

sites, and associated waste facilities. What exist in the “Nature and protection and reclamation fund” is inadequate for its purpose, and in cases when the operations have had a history of being state owned (before privatisation) there has been no formal division of liability between the state and the new owner;

- d. given the high seismic risk, and overall high risk for land instability, there exist excessive risks for waste facility collapses and/or accidents, caused by the inappropriate method of construction (the use of “up-stream raise” designs) that is used for tailings impoundment construction;
- e. in the non-metal and metal sector alike, mined out areas are commonly left without any significant efforts made for rehabilitation and reclamation.

Environmental laws and regulations that could potentially address most of the above problems exist. However, these laws are not properly implemented, and there are also significant problems related to legal ambiguity and of laws not being streamlined. There are also concerns that the fines and consequences for not being in compliance with existing environmental laws are too low and not constituting a sufficient deterrent. Further, among many companies, especially the smaller ones, there may be a lack of knowledge of laws, as well as a poor understanding of what is required in order to be compliant with laws.

The existence of a large number of no-longer mined, or no longer used mines and waste facilities represent a significant environmental liability. There may exist opportunities for economic re-mining/re-processing of some of these sites although experience from other countries suggest that the bulk of the liabilities will need to be addressed by government through rehabilitation and mitigating measures.

Mining operations are providing employment and livelihoods, and they do so in many areas where other economic opportunities are scarce. Further, in some mining communities, support for operations appears to be relatively strong. At the same time, one cannot say that there exist a widespread “social license to operate” for miners in Armenia. The lack of widespread support for mining in Armenia can, in turn, be seen to be rooted in real shortcomings on environmental and economic issues. Further, a prevailing culture of secrecy that is prevalent in the sector (on part of both companies and authorities), hinders both meaningful public participation as well as decision making based on true and factual information. Initiatives to make data publicly available for public scrutiny are therefore needed.

Although there exist a substantial number of qualified mine workers in Armenia, there appears to be a lack of more advanced skills. The lack of local management capacity is representing a constraint to the social sustainability of the operations. Similarly, women are severely underrepresented in the sector. This does not only represent a waste of skills and abilities, but also undoubtedly contributes to less well balanced and less well functioning work places, and mine communities.

In summary, none of the existing metal mining operators in Armenia are in line with all three components of sustainability, and available evidence suggest that the same is likely to be the case for the majority of the non-metal mining operations. Further, there are examples of operations that appear unviable in terms of all three components of sustainability, and this is appears to be especially prevalent among the smaller operators in the metal mining sector. The reasons for the shortcomings are found in a mixture of failings, including companies’ irresponsible behaviour, as well as failures by the institutions that are charged with supervising and controlling these activities. Some failings in the regulatory framework are also of importance as a reason for some specific failings, although the overall conclusion in this regard is that the main problems relate to a failure of implementation of existing laws.

It is suggested a significant part of the overall controversy that surrounds mineral related projects in Armenia is caused by a lack of knowledge and data, and also a limited knowledge of best practices and technology used in modern mining operations. With regards to the former, the ongoing work in preparing an EITI candidature application, and the work that is entailed in the subsequent implementation of the EITI standard will contribute substantially to establishing a better understanding of the sector. With regards to technology, there may exist considerable opportunity to introduce more modern, safer and environmentally more friendly technologies in the sector. A further consideration in this regards relate to the suitability of SME involvement in the mining sector. Whereas the exploration field and

possibly also some forms of quarrying and dimension stone extraction constitutes suitable areas for SME involvement and development, actual metal mining and processing may be one of the least suitable sectors for such SME participation. This follows as such activities, if they are to be done properly, require longer term management and stewardship, as well as access to considerable resources and funds to operate a mine, also in times of lower commodity prices or after accidents and/or mishaps.

Recommendations

The report shows that whereas mining is important to the Armenian economy, individual operations are not generally contributing sufficiently to the longer term sustainable development of the nation. This is in spite of a range of past and ongoing initiatives taken by the regulators to reform the sector. These initiatives have, however, been taken without reference to a policy or longer term strategy.

The world's commodity markets are presently depressed, with generally low prices and low demand. However, the mining sector is cyclical and sooner or later, there will be an upswing in the market, and new investment will follow. Thus, the present is a fortuitous time for mining policy development, to ensure that when the next wave of development and investments arrives, Armenia will be well prepared to manage the various challenges and opportunities that such times entail.

Thus, this report's main recommendation is to urgently embark on a process of developing a national mining policy. Such a process will take at least one year to complete, and it is strongly recommended that the process for developing said policy is coupled with the efforts made in making Armenia an EITI compliant country. The main point of having such a policy is that it helps in ensuring that development and regulation of the sector holds together, and contributes to the achievement of an overall vision for national development. Furthermore, the process of developing a policy is important in itself as it provides an opportunity to build consensus and a shared understanding of issues among affected stakeholders. Whilst the process of policy development is ongoing, it is recommended that non-urgent reforms and legislative developments in the mining sector are put on hold. However, there are some priority actions and initiatives that are needed irrespective of the outcomes of policy development, and recommendations for these are therefore provided (further below).

The development of the mining policy should be based on a vision of what the future minerals sector should look like. The broad vision could include that the sector should contribute to sustainable and equitable economic development; that benefits should be shared at the national level, whilst ensuring that communities that are directly impacted by minerals related projects are not adversely affected economically or socially, and not either exposed to excessive risks related to possible emergencies or accidents. In establishing the vision, it would be helpful to paint a rather concrete picture of what the sector could look like. For example, based on the findings and recommendations of this report it is suggested that the future situation should be one where there are fewer mines and quarries but that these have considerably larger production than today. Further, the operations should be more mechanised and modern and performing in an environmentally responsible way, and with adequate concerns for health and safety of their workers. In addition, there should exist a number of advanced exploration projects, in turn based on the outcomes from an active and innovative exploration sector. The sector as a whole should be supported by linkages to local businesses, consultancy companies and all of these should to a dominant degree hire well qualified Armenian staff that have had the opportunity to receive high quality training both locally and internationally.

Questions that may be addressed in the policy development process include which type of mines can meaningfully contribute to sustainable development goals; what economic development related to mining shall be promoted; what shall be the roles and responsibilities of the state and the companies and their owners. These types of questions be addresses through formulating policy statements, which together contribute to achieving the overall vision.

The development of the policy will, in a similar way to the EITI process, provide an opportunity for broader cooperation/interaction between institutions, as well as among civil society and private com-

panies. Thus, it is suggested that the process for policy development be coupled to the EITI process, and also that it is managed in a similar way. Thus, it is suggested that there could be an implementing group, chaired by the Ministry of Finance (or PM), and including the sector ministries and authorities that are most concerned (MoENR, MoE, MES). The consultative process should include CSOs, private companies, local community representatives from mining districts, as well as central and regional authorities.

The implementation of the policy should include a number of diagnostic studies, that will fill the knowledge gaps that exist, and thus ensuring that policy implementation is done whilst having a true and reliable understanding of the current situation (the baseline). The diagnostic studies, will also serve to identify the means and measures (technical, financial, human resources) necessary for achieving the policy. The following diagnostic studies are recommended, most of which may to an extent build upon the findings of this present report: (i) Sectoral Environmental and Social Assessment, including practical proposals for how any negative issues identified can be addressed, and positive development opportunities facilitated, and including considerations for how the environmental liability in operations that have previously been state owned should be apportioned. (ii) Geotechnical risk assessment, where the risks represented by existing geotechnical structures and methods for design used in Armenia are identified and where proposals for regulatory changes to reduce any identified and excessive risks is provided; (iii) Economic assessment, where different types of mining projects' economic viability, including those championed by SMEs, are considered, as well as their respective contribution to local, regional and national economies; (iv) Technology Assessment, where the technology used at various mining projects in Armenia is assessed, and areas where increased mechanisation and/or better management may be required are identified; (v) Health and Safety review, which identifies possible needs and requirements in this regard; and (vi) an Institutional review, where the relevance and effectiveness of current institutional tasks and practises are assessed in the light of the common goal of achieving sustainable minerals sector development, and recommendations for improvements are provided.

Recommendations are provided for initiatives which are needed irrespective of the outcome of the minerals policy development process. Some of these are concerned with issues that to varying degrees are to be addressed by the EITI process which in turn, means that one overall and strong recommendation is that the ongoing work towards achieving EITI candidate status be continued. The remainder of the actions are classified as being: urgent, and in need to be initiated immediately; actions needed in the medium (initiated within 24 months); and longer term actions (> 24 months):

Actions that to varying extent are related to the requirements of the EITI process include to: increase public awareness; publish mining and exploration license data; provision of descriptive information on how the sector is regulated and managed; collect and make available existing data on the mining sector; and assessment of the economic viability of mining projects, and the benefit streams that flow from the sector.

Immediate actions are proposed to address issues that are either representing urgent risk to people and/or the environment, and to issues that are constraining positive developments in the mining sector. These include: addressing urgent security risks at both former and present mining operations; development of guidelines for the safe design of mine waste facilities; coordinate donors and existing mining sector development related initiatives.

In the medium term, initiatives that are deemed necessary include: collect and make available geological and environmental monitoring data; make a detailed inventory and risk assessment of polluted and or abandoned mine sites; encourage private sector led initiatives that help ensure that projects contribute to sustainable development (i.e. CSR related activities, as well as the formation of a company organisation such as a Chamber of Mines & Minerals that can champion efforts to improve business ethics and behaviours); development of a computerised mining cadastre; and the review and update of mineral related legislation, in line with the new mineral policy.

In the slightly longer term, initiatives that will underpin the further development of the sector are proposed. These include: efforts to attract responsible, and financially strong investors; address capacity building needs at the minerals related public institutions; and to strengthen public awareness and thereby possible participation in mining sector decision-making, specifically in areas where mining activities are already ongoing.

1. Introduction

This report provides a review of the Armenian mining sector, and assesses its potential to contribute to sustainable economic growth and development. It further provides recommendations for the initiatives and actions that will be required for such development to take place, and considers the risk and opportunities that this may entail.

The report was produced in the period October 2015 to February 2016. It was commissioned by the World Bank with the aim to assist the Armenian government to gain a better understanding of key social and environmental challenges and future opportunities for the Armenian Mining Sector, looking both at the legacy of previous mining operations, current mining, and potential new projects in order to inform and support the development of a strategy that adheres to international good practices and contributes to sustainable development.

The findings of this report are based on desktop reviews of existing documents, on a large number of meetings and interviews with affected and interested stakeholders, and on field work performed in the southern, central and northern parts of the country. There have also been three thematic workshops (two in Yerevan, and one in Kapan), and one final stakeholder workshop (in Yerevan) where the findings of the work were presented, and where a large body of feedback was received from participants. Comments, suggestions and corrections on a draft version of this report has been provided by representatives of the GoA, and the World Bank. Further, oversight and feedback was continuously provided by representatives of the World Bank.

1.1. Introduction to mining sector development

Mining is a primary industry which we cannot completely do without. While technologies for recycling are increasingly improving, the need for new mining will in all likelihood increase over the next few decades. The mining sector, globally, may be divided into three main subsectors: coal mining; metals and precious minerals mining; and the quarrying for industrial minerals, aggregates and dimension stone. In Armenia, coal mining is not of significant importance, whereas underground water (fresh and mineralised) forms an additional mining subsector, which is partly regulated under the RA Mining Code.

Aggregates mining (mainly quarrying for gravel and sand) is vital for the functioning of any society, but the sector's economic value is usually small. Industrial minerals (limestone, clay, potash etc.) and dimension stone mining is similarly vital for society but as the value to bulk ratio of the products is small, the potential for export and import is generally limited, and the sector's economic importance is also comparatively small. With regards to aggregates, dimension stone and industrial minerals, these types of deposits are not generally rare, and the technology needed for finding and exploiting them is straight forward. This in turn means that most countries have developed this sector domestically.

The metals and precious minerals mining sector produces low bulk, high value products. Although access to such commodities is necessary for all countries' economies to function, it is not necessary for all individual countries to have such an industry, as these commodities are readily traded in the world market. Further, the possibility of developing such mining domestically relies primarily on the existence of prospective geology, on the access to relatively advanced technology both for prospecting and exploitation, as well as the availability of substantial financial resources. Given that metals and precious minerals have high value and that they can bring considerable export incomes, most countries that do have prospective geology choose to utilise this advantage to build up a metals and precious minerals mining sector. Ideally, this is done in a way so that it links with other sectors of the economy, and is used as a way for fostering wider societal gains and economic development.

The development of a modern metals and precious minerals project, from early exploration to the

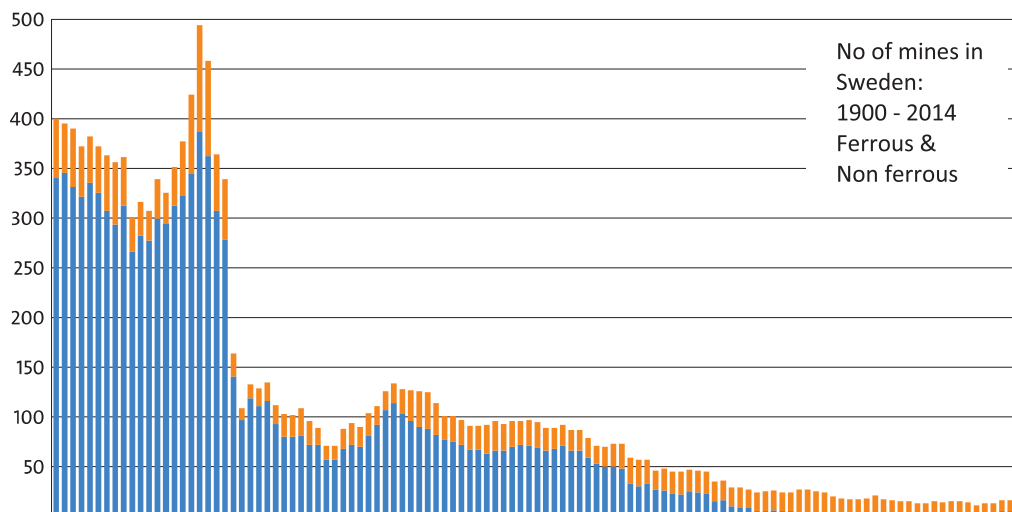
start of industrial-scale production usually takes 10-15 years or more (Table 1.1). This time is needed to carry out detailed resource estimates, to do the various metallurgical, geotechnical, financial and environmental studies necessary for a bankable feasibility study, and to arrange financing and mineral and environmental permitting. The management of the sector needs to be characterised by a similarly long-term view. Further, post-production, mine closure and rehabilitation usually takes a couple of years or more, and this is sometimes followed by a prolonged period of environmental monitoring, depending on the type of mine.

Few exploration projects actually lead to mine development. For example, looking at major metals, over a recent 2-year period, 26 out of 710 (3.7%) greenfield discoveries in Canada reached feasibility stage¹. For Australia, the numbers were 32 out of 570, or 5.6%. Far fewer projects would survive all the way to the mine construction stage.

Table 1.1. Common time periods (years) for the different phases of mineral development projects.

Exploration & feasibility study	5-15
Mine construction	1-2
Production	10-30
Mine closure & reclamation	1-2
Monitoring	5+

Modern mining is being conducted at increasingly larger scales. The driving factors behind this development include that: operations are becoming increasingly mechanised and efficient, which means that lower grade and larger deposits may be mined; and that more stringent environmental (and social) requirements make it more difficult for small operators to achieve the level of performance that is required. This development is true both for metal and precious minerals mining, as well as for industrial minerals mining. In Sweden, for example, the last century has seen a dramatic decrease in the number of metal mines in operation, at the same time as ore production has increased more than tenfold (Figure 1.1).



¹ Raw Materials Group (2013).

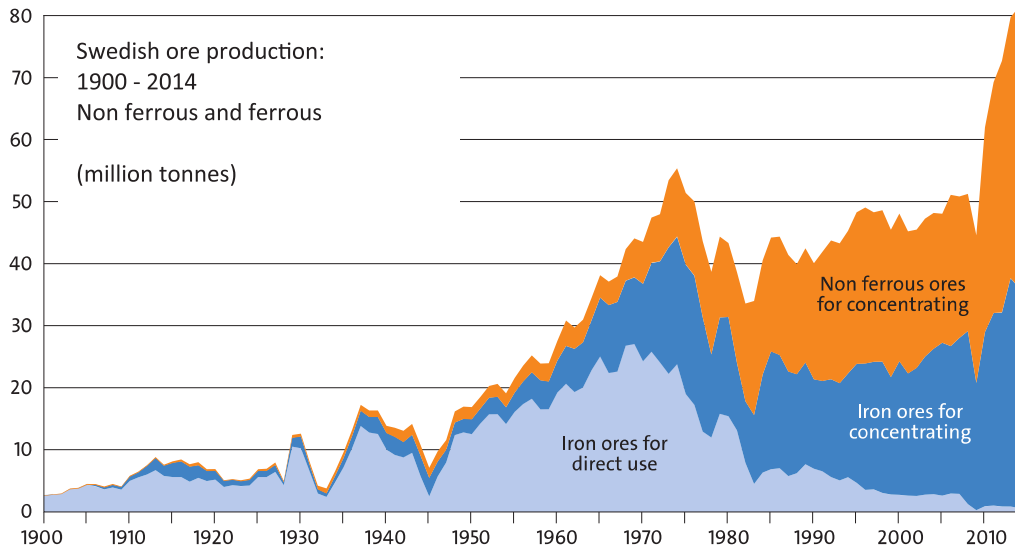


Figure 1.1. Illustration of how (metal) mining operations in Sweden over the last century have become fewer in numbers, but much larger in terms of the production of each mine. This development has been caused by increased mechanisation, efficiency and by more stringent regulatory requirements.

The needs and requirements for establishing a mine are dependent upon which commodity is being considered. High bulk commodities such as iron ore and coal are crucially dependent upon the availability of infrastructure for transport (railroads, harbours), and other supporting industries and activities (often referred to as “linkages”). Conversely, mines for low bulk commodities (e.g. gold) may be initiated with a comparatively lesser need for associated linkages and infrastructure.

Mining is a cyclical business, with commodity prices varying in what is sometimes referred to as “super cycles”, which in turn may span over one or several decades. Thus, the decade preceding 2005 (and the rise of demand from China) was characterised by low commodity prices, and limited exploration. In contrast, the period 2005 -2011 represented a boom in the mining sector, fuelled to a great extent by Chinese demand. The years since 2011 has seen a slowing down and decreases in commodity prices, and at present we are in a period of comparatively lower investor interest in the minerals sector. The management of the sector needs to take these fundamental characteristics into account.

The mining sector holds substantial prospects for fostering development and economic growth. The sector is, however, also seen to be associated with a number of less desirable characteristics such as environmental impacts, socio-economic unrest, land-use conflict, financial instability, and due to the large amounts of money involved, to be prone to corruption and illicit financial transactions. Measures are needed to address these problem areas, such as the development of a suitable regulatory regime as well as the building of institutional capacity to implement such a regime.

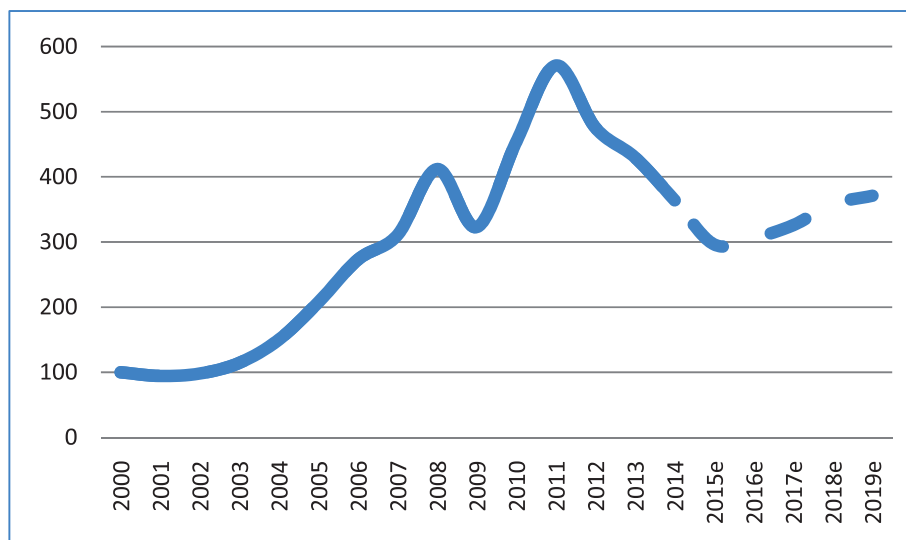


Figure 1.2. Variations in “metal price index” since 2000 (with 2000 given an index of 100). Source: SNL Metals & Mining (2014).

1.2. The Armenian geopolitical setting and political overview

Armenia is a small country, situated in a region which is both geopolitically complex and volatile. As a direct consequence, Armenia’s development is heavily dependent on events that take place in neighbouring countries, as well as in the region. Since its independence from the Soviet Union in 1991, Armenia has maintained strong economic and political relations with Russia, and Armenia is since 2015 a member of the Eurasian Economic Union. Armenia’s relations with its western and eastern neighbours have been less stable. The conflict in Nagorno Karabakh remains unresolved. Armenia has no political relations with Turkey. Further, although relations with Iran are cordial, the fact that Iran has until recently been under economic sanctions, mean that trade and contacts southwards have been constrained. This, in turn, means that the major land based route for trade in and out of Armenia runs through Georgia in the north.

Table 1.2. Summary facts on Armenia

Capital: Yerevan (about 1.1 million)
Area: 29,743 km ²
GDP per capita (2014): USD3,500
Population: 3 million Population density: 101/ km ²
Life expectancy: 71 years
Fertility rate: 1.74
Literacy rate: >99%
Currency: Armenian dram
Neighbouring countries: Azerbaijan, Turkey, Georgia, Iran

Since independence, the Republic of Armenia has been governed by a Constitution that was approved by referendum in 1995 (with amendments in 2005 and reform in 2015). The legislative branch of government is the National Assembly, whereas the executive branch of government is headed by a Prime Minister, appointed by an independently elected President. The President is elected every five years and can serve no more than two consecutive terms.

The highest court of the judicial branch of government is the Constitutional Court, which has the authority to decide on whether acts of the President, National Assembly, or the Government are in compliance with the Constitution. The nine members of the Court are appointed by the National Assembly (5) and the President (4).

The party with a current majority in the National Assembly is the Republican Party, a national-conservative party. The current President, Serzh Sargsyan, is also leader of the Republican Party.

Armenia is divided into ten Marzes (provinces), plus the City of Yerevan, the nation capital, which is an independent jurisdiction. The Marzpets (Marz Governors) implement the national government's regional policy, and coordinate the activities of local branches of the executive authority.

BOX: How free is Armenia?

Freedom House, an international NGO, currently rates Armenia at 4.5 on its seven-point scale that combines political rights (electoral process, political participation, and functioning of government) and civil liberties (freedom of expression, associational rights, rule of law, personal autonomy), where 1 means most free and 7 signifies least free (Freedom of the World, 2016). Compared to other countries in the region, Armenia is freer than Azerbaijan (6.5), Russia (6), and Iran (6) but less free than Georgia (3) and Turkey (3.5).

2. Geology, mining and exploration activities

2.1. Regional geology and metallogeny

The geology of the Caucasus region is a result of geologically recent events related to the convergence and collision of the Africa-Arabian continental plate (to the south) and the Eurasian plate (to the north) in late Cenozoic times. Thus, the area is still tectonically active with a common occurrence of earthquakes, and volcanic activity occurred as recently as in the Holocene epoch of the Quaternary period (<11.7 thousand years ago).

Armenia lies almost entirely within the Lesser Caucasus, the southern part of the Caucasus region, and the geology of Armenia (Figure 2.1) extends into Georgia, Azerbaijan and northern Iran. This follows from the direction of the collision between the Africa-Arabian and Eurasian plates (roughly SW-NE), which resulted in general NW-SE structural trends throughout the Caucasus.

Following from its setting in a continental margin, with abundant volcanism (and associated geological processes at depth), and the addition of exotic geological terrains to the Eurasian continental margin, Armenia has a diverse and prospective geology from a mineralization point of view. Given by the geological setting and information on historical mining, Armenia is mostly prospective for copper and gold. Molybdenum associated with the copper, and silver associated with gold, as well as additional base metals such as zinc and lead, may locally be of additional interest.

For metallic minerals, the areas with Jurassic to Paleogene geology, intersected by granitoids (Figure 2.1) are the most prospective. Within these areas, the best deposits discovered and mined so far are confined primarily to three regions, including: (i) the Alaverdi region in the north with mainly polymetallic (e.g. Akhtala) and copper (e.g. Alaverdi and Shamlug) VMS type deposits as well as porphyry copper deposits (e.g. Teghut); (ii) the Kapan area in the southeast, which has a geology similar to that of the Alaverdi area, thus also hosting copper (e.g. Kapan-Central) and polymetallic (e.g. Shahumyan) VMS deposits. This type of geology can be traced from Georgia through north-eastern Armenia to the Kapan area, and into Iran; (iii) the area of the Zangezur mountain range in the southwest, stretching from Meghri for some 50km to the NNW, where a number of copper and copper-molybdenum deposits are located (e.g. Kajaran and Agarak).

Gold is sometimes found in the abovementioned type of polymetallic deposits. Furthermore, the Amulsar and other gold projects in Vyots Dzor, the Sotk gold mine east of southern Lake Sevan, and a number of gold deposits west of northern Lake Sevan (see Section 2.3) shows that other parts of Armenia are prospective for gold.

Outside Armenia, on the extension of the lesser Caucasus some 25-30km southeast of Armenia in Iran, is the Sungun Cu-Mo mine. Sungun has reserves of at least 700Mt at copper grades of 0.6-0.7% (Osanloo and Ataei, 1998; Etmian, 2012), which makes it one of the largest and highest grade porphyry copper deposits in the world. Together with the Kajaran deposit, it clearly demonstrates the porphyry copper potential of the Zangezur mountain range. There are no other large mines in the area of the Lesser Caucasus around Armenia while the small-medium scale Madneuli Cu-Au mine in southern Georgia is similar in style and scale to some of the deposits in the Alaverdi area.

GEOLOGICAL MAP



Figure 2.1. Geological map of Armenia

In “mining countries” globally, deposits that are relatively easy to find, such as large outcropping deposits, have to a large extent already been discovered. Even in a country that has a geological setting prospective for metals, such as Armenia, finding additional economic deposits requires high quality and long-term exploration work. Bearing in mind that there has been little recent high-quality geological exploration undertaken in Armenia, that Soviet-era exploration used what is now outdated techniques and was focussed mainly on finding large-scale deposits, and that much of the prospective geology is “hidden” under Miocene-Quaternary cover (Figure 2.1), Armenia may still be prospective, in particular for copper and gold. The Amulsar project, which plans for the production of reasonably large amounts of gold (about 200,000 oz/yr for 10 yrs, see below), lends support to this view.

The geological structures and rock compositions of Armenia allows for quarrying and production of a variety of dimension stone (mainly tuff, gabbroids, basalt/andesite and marble) and aggregates (sand, gravel, and crushed rock) to fulfil the domestic demand. In particular, some tuff varieties are also of

quality amenable for export. Concerning other non-metallic minerals, Armenia has deposits with quality grades of perlite, bentonite, diatomite and zeolites. There are also some deposits with semi-precious stones, such as agate and jasper.

2.2. Geological data and information

In Armenia, there is no public organization performing geological surveys and there has not been any regional (or more detailed) geological mapping, mineral exploration work, or assessment of mineral deposits undertaken by the State since the onset of the privatization of the minerals sector in the mid-1990's. Thus, while there are some more recent geological maps published (e.g. 1:500,000 national geological map from 2005), these are based on mapping work performed in the past.

Rather extensive exploration work was undertaken during Soviet times. The results are presented in around 1,488 extensive reports on mineral deposits, which include appendices with narrative descriptions and figures. The reports are housed at the Republican Geological Fund, SNCO and they constitute a wealth of information that should be of interest for new exploration initiatives.

2.3. Mining and mine prospects in Armenia

Metal mining

Metal mining has a long history in Armenia and copper mining began in the Alaverdi area in northern Armenia in the 1770s. In the 1840s, copper mining started in Kapan, and in the middle of the 20th century the larger Kajaran copper-molybdenum mine started production. Over the last fifty years, additional smaller mines have opened, some of which are operational today (e.g. the Agarak copper-molybdenum mine and the Shahumyan polymetallic mine). Despite the long history of mining, a sizeable and diverse mining sector has never developed but the sector is today characterized by a number of small to medium sized projects, many of which appear not to be economically viable, and there is only one large and stably operating mine, namely, Kajaran (Table 2.1).

Thus, there are 27 granted rights for metal mining (Table 2.1; Figure 2.2), 14 of which are for mines in operation and 13 for projects that are still at the exploration stage. Of the 14 operational mines, 8 have been running at an amalgamated loss over the period 2010-2014 (table 2.1; yellow high-light), and most of these have been making a loss each individual year (see further Chapter 6 for an economic assessment of the industry). In general, loss-making mining projects do often not operate on a continuous basis, and a couple of small mines were also seen not to be operating when visited within this project.

Overall, copper and gold are the principal metals produced in Armenia. Contrary to common belief, the contribution from molybdenum to the metal mining turnover is insignificant (less than 1% of the mined value). Zinc, lead and silver are also of little importance to the overall output, while they are locally important, most notably at Shahumyan.

The Kajaran copper-molybdenum mine produces some 18.5Mt of ore per year (as compared to the permitted 12.5 Mt/yr, table 2.1) at grades of 0.25% Cu and 0.03% Mo. Kajaran's production makes up 60% of the turnover of the Armenian mining sector. According to information from MENR, approved ore reserves amount to 2,244Mt and it is estimated the mine could operate for another 100-120 years.

Table 2.1. Metal mining permits on 1 December 2015 with permitted (not actual) annual ore extraction and metals production (data from MENR); Au and Cu grades estimated from the ore extraction and metals production data; Value (USD) of permitted annual metal production estimated based on metal prices in December 2014; Green – companies with a total profit over last 5 years; Yellow – companies with a total loss over last five years (data from MoF); White – not operational (No. 25: Teghut opened in late 2014, thus no profit data).

	Company	Mine	Ore ('tons)	Au (kg)	Ag (tons)	Cu (tons)	Mo (tons)	Zn (tons)	Pb (tons)	Fe (tons)	Grade Au (g/t)	Grade Cu (%)	Profit 2010-2014 (USD)
1	Multi Group Concern LLC	Mghart	10	83	0,1						8,3		2 292 655
2	"Yardani Zartonk" LLC	Sophie	10	46	0,4		108	75			4,6		
3	Assat LLC	Karaberd	25	135	1,2						5,4		
4	Sipan 1, LLC	Tertasar	30	414	2,5	111					13,8	0,37%	
5	AT Metals LLC	Meghrasar	46	nd	nd								
6	Marjan Mining Company Ltd	Marjan	50	172	4,4	70	625	475			3,4	0,14%	
7	Meghradzor Gold LLC	Meghradzor	60	816	1,3						13,6		1 743 551
8	Mega Gold LLC	Tukhmanuk	77	487	2,7						6,4		-1 033 956
9	Akhtala Mining Plant CJSC	Shamlugh	100			3 530						3,53%	-1 193 862
10	Baktek Eco LLC	Arjut	100	nd	nd	nd							
11	Paramount Gold Mining Ltd	Meghradzor, Lusajur	150	3 004	5,4						20,0		167 640
12	Ler-Ex Ltd	Hankasari	150			735	306					0,49%	-8 428 992
13	Elvi Gold Mining CJSC	Lichqvas tey	200	1 178	7,0	880					5,9	0,44%	
14	Sagamar CJSC	Armanis	300	660	4,4	2 370		5 760	5 610		2,2	0,79%	-12 265 761
15	Vayq Gold LLC	Azatek	300	765	17,1	585					2,6	0,20%	
16	Active Lemagorts LLC	Aigedzor, Central	320			544	153					0,17%	
17	Tatstoun LLC	Lichk	500			3 050						0,61%	

Another porphyry copper mine that could become a significant producer is Vallex Group’s Teghut mine in Lori province, which commenced operation in the end of 2014. According to the company’s homepage (accessed on 7 January 2016), the ore reserves amount to more than 454Mt at grades of 0.36% Cu and 0.02% Mo. The processing plant is designed for a capacity of 7Mt/yr. Thus, subject to the efficiency of the processing plants, the copper production could theoretically be about half that of Kajaran.

With regards to gold, the Sotk mine is the main producer, and gold is also of major importance at Dundee Precious Metals Shahumyan mine. Reported gold grades at several smaller mines are often high to extremely high, which apparently makes some small deposits economic (Table 2.1; Mghart, Meghradzor, and Meghradzor – Lusajur). However, the reserves tonnages at these mines are so small that they would be expected to have a very short mine life.

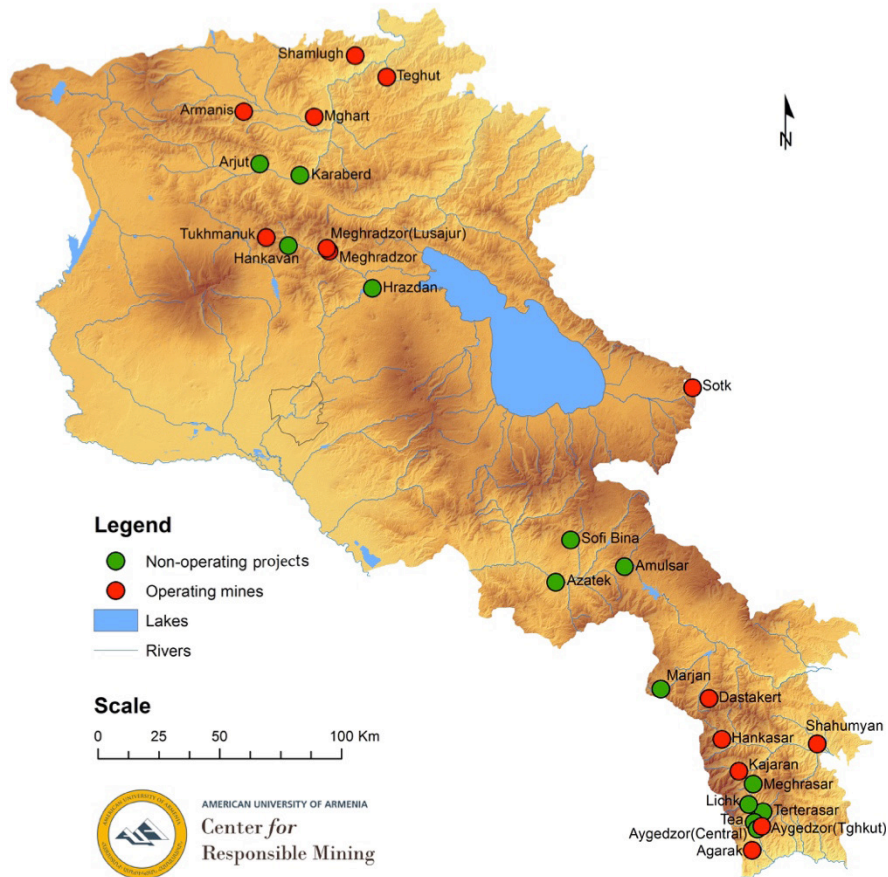


Figure 2.2. Metal mining projects in Armenia.

In contrast to the many high grade / low tonnage gold projects, Lydian International’s (Geoteam CJSC in Table 2.1) Amulsar project is a low grade / large volume deposit. The project has completed a feasibility study and secured most of the financing estimated to be needed for mine construction. According to the company’s homepage (accessed on 7 January 2016) proven reserves (at 0.20 g/t Au cut-off) amount to some 67Mt at grades of 0.79 g/t Au and 3,68 g/t silver. Lydian plan for a gold production of 200,000 oz/yr (5,700 kg/yr) for a mine life of 10 years. The value of the yearly production over the 10 years of operation, at current metal prices, would be on par with the value of the production at Kajaran, i.e. 200 million USD.

Industrial minerals

There are about 440 permits for mining or quarrying of industrial minerals in Armenia, and the vast majority are for dimension stone, aggregates², or materials otherwise used for construction purposes (Table 2.2).

Table 2.2. Approximate number of mining permits for different types of industrial minerals in Armenia. Apart from the last category (other industrial minerals), the numbers are not exact as some permits include more than one type of industrial mineral.

Material	Common use	Number of permits
Tuff	Dimension stone	115
Basalt, andesite, dolerite	Dimension stone; aggregate	100
Sand and gravel	Aggregate	70
Travertine	Dimension stone	35
Intrusive igneous rocks, e.g. granite, tonalite, diorite, gabbro etc.	Dimension stone, aggregate	20
Pumice	Construction (e.g. cinder cones), aggregates	25
Volcanic slag	Aggregate	15
Gypsum	Masonry, construction board, cement raw material	15
Marble	Dimension stone	10
Limestone	Dimension stone, cement raw material,	10
Other dimension or ornamental stone, e.g. conglomerate, sandstone, breccias	Dimension stone	10
Other industrial minerals; perlite (5), bentonite (2), diatomite (1), magnesite (1)	Various types of use based on the physical and/or chemical properties of the material	9

Tuff is mainly quarried in western Armenia in Aragatsotn, Armavir and Shirak (Figure 2.3a). There is a variety of tuff and some qualities are amenable for export. In the past, tuff sourced from Armenia was used widely as a dimension stone across the Soviet Union. Today, the geopolitical setting of Armenia makes export difficult, while some companies apparently export smaller amounts of dimension stone. Quarrying of other types of dimension stone are also to a large confined to specific areas where quality grades occur (cf. Figure 2.3a).

Aggregate quarrying is strongly focussed to the central parts of the country, which is also the primary area of development and urbanization. Thus, most of the sand and gravel quarries are located in the Ararat and Armavir regions in the west, while a number of quarries are also found in the northern parts of the country (Figure 2.3b). Basalt and andesite, pumice, and volcanic slag quarrying is strongly concentrated to the area around Yerevan (Figure 2.3b).

² Aggregates refer to coarse particulate material used in construction, commonly including sand, gravel and crushed stone. In Armenia, basalt, andesite and dolerite often crushed and used as aggregate while it is also used as ornamental and dimension stone.

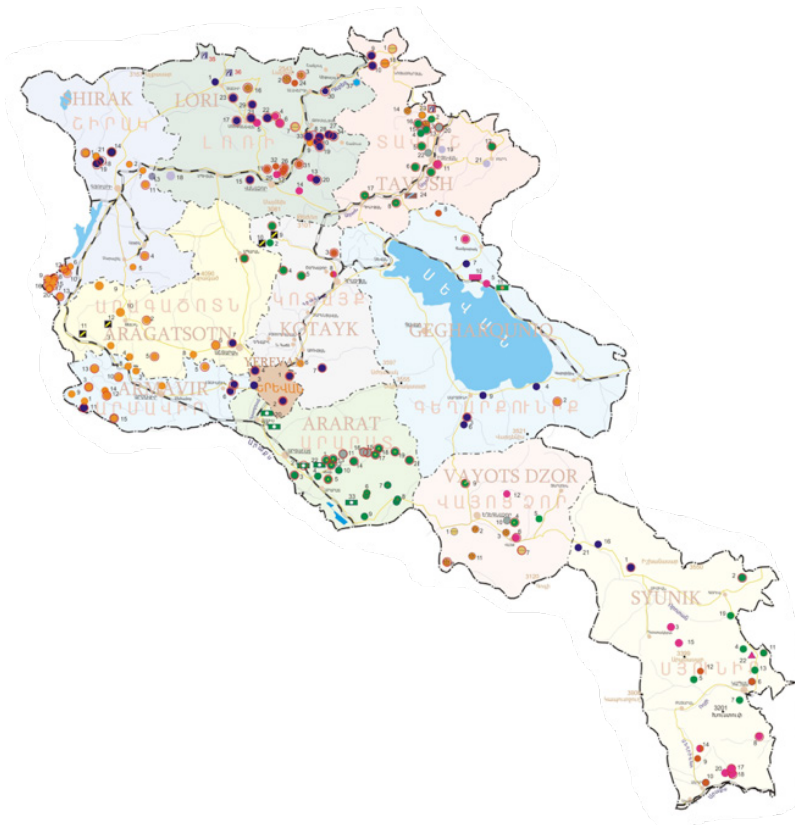


Figure 2.3a. Location of dimension stone quarries in Armenia, 2010 (map from MENR homepage). Key products: Orange – tuff; Dark blue – basalt, andesite; Green – marble, travertine; Pink – mafic igneous rocks, e.g. gabbro, diorite.



Figure 2.3b. Location of quarries for aggregates in Armenia, 2010 (map from MENR homepage). Key products: Yellow circles – sand & gravel; Lilac squares – basalt, andesite; Brown circles – volcanic slag; Light brown circles – pumice.

Despite the relatively large number of quarries, the total production of dimension stone and aggregates in Armenia is small in relation to the size of the country (Figure 2.4). This means that each operation is small and/or that production methods are inefficient. To judge from field visits and interviews with governmental institutions, the former appears to be largely true. This type of sector with several hundred small, and to a large extent poorly run mines, would be challenging to regulate and supervise efficiently.

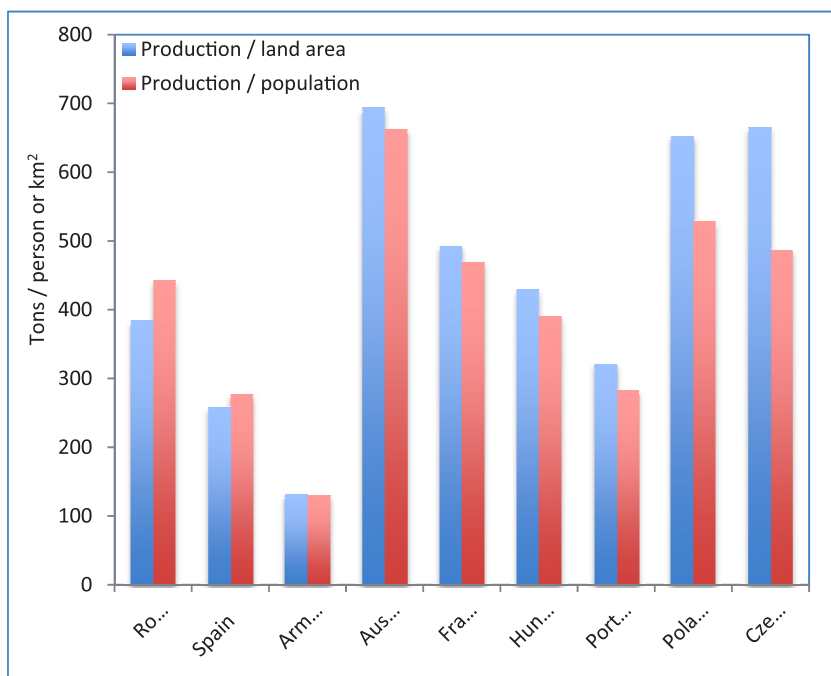


Figure 2.4. Aggregates and dimension stone production in relation to country size and country population. Population densities of the countries range from about 80-140, left to right. Data sources: MENR (www.minenergy.am); European Commission – Eurostat (ec.europa.eu/Eurostat); Minerals UK (www.bgs.ac.uk/mineralsuk/statistics).

The production of other types of industrial minerals in Armenia is also overall small and limited to a handful products (Table 2.3). In the past, very large amounts of perlite were produced (some 2,200,000 tons in 1990), which made Armenia the largest producer among the FSU states and Armenia has also in more recent years (since independence) exported perlite to European and neighbouring markets. A major part of the perlite was, nevertheless, used as light-weight concrete aggregate while the quality is apparently such that other industrial use (e.g. filter powders, glass manufacturing, and heat insulation) could be developed. Today the production of perlite is much smaller but still some 2.2% of the world production.

Bentonite and diatomite were also mined at much larger scales in the past while today their share of the world production is 0.9% and 0.1%, respectively. Considering past mining, and the fact that there seems to have been little development towards production of different qualities (in particular for high-end use), there appears to be scope for development of the industrial minerals sector.

Table 2.3. Industrial minerals production from 2009-2013 in metric tons (Source: World Mining Data; Reichl et al., 2015).

	2009	2010	2011	2012	2013
Perlite	84,100	74,200	74,600	0	62,600
Bentonite	4,800	1,400	5,000	7,500	18,500
Diatomite	0	31,100	29,200	29,150	19,400
Gypsum	40,100	38,700	34,000	30,400	28,700
Salt	39,000	38,000	106,000	172,000	136,000

2.4. Exploration activities

There has been very little recent greenfield exploration undertaken by the private sector in Armenia, and current exploration efforts focus mostly on attempts to develop deposits known from historical exploration work.

There are currently (as of December 2015) 44 permits for metals exploration (Figure 2.5). Most of these are for polymetallic +/- gold (19); gold (16), and; copper +/- molybdenum (7), and most are located in the north and south where most of the historical and current mines are also located (Figure 2.5). There are, nevertheless, some permits in the central parts of Armenia, including one very large permit in the area of Lydian's Amulsar gold project.

Considering the fact that Armenia has prospective geology, the number of exploration permits is small. Furthermore, none of the exploration licenses are held (directly or indirectly) by well-known international mining companies, and there appears to be little international interest in investing into exploration in Armenia.

The total area covered by exploration licenses (Figure 2.5) amounts to about 5% of Armenia's land area, which is about twice that figure for Sweden (2.4%), while in some countries with more focussed efforts on developing the mineral sector, the exploration license coverage is substantially higher than 5%. In this respect, Uganda constitutes an interesting example. Over the last 10 years, the Ugandan Government has implemented a number of projects aimed at enhancing geological knowledge and structuring legal and institutional frameworks. This has resulted in that a few hundred exploration licenses today cover some 30-40% of the country, while previously the exploration sector was essentially dormant.

From discussions with key informants during this project, the majority of the exploration projects seem not to be at an advanced stage, and it is concluded that exploration in Armenia is neither advanced nor very extensive geographically, and there is relatively little greenfield exploration being undertaken.

Concerning non-metal minerals and semi-precious stones, there are 21 permits (as per December 2015) including exploration for opalit, nepheline, diatomite, jasper, limestone, sand, gravel, basalt, tuff, sandstone, pumice, travertine, breccia and clays.

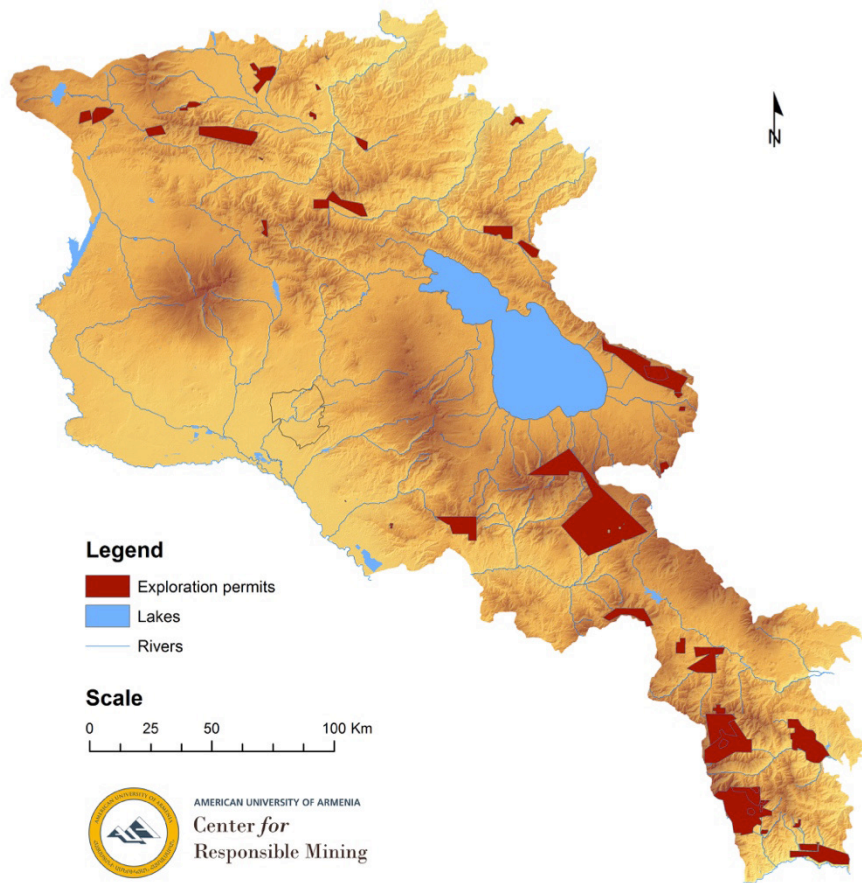


Figure 2.5. Exploration permits for metallic minerals as per 1 December 2015.

2.5. Outlook for the future

The large reserves at Kajaran would ensure the longer term operation, but this is subject to external and unpredictable risks, such as copper price fluctuations and environmental emergencies (e.g. significant failure of tailings dam); the latter which could halt operations for a significant period of time, and in a worst case even be too costly to remediate. With regards to metal price fluctuations, over the time period 2010-2014, the copper price decreased by 37%, which is likely to be the key reason for ZCMC's decrease in profit by 45% over the same time period.

While the Teghut copper (and molybdenum) mine, at the initially planned production rate, and the planned mining at Amulsar (gold) would together add a mineral value which could be about 1.5 times that of Kajaran's current production, the opening of new mines is always associated with financial and technical risks, and it is in many cases only possible to verify that an operation is sustainable after a couple of years of mine commissioning. Thus, the longer term performance of the Teghut and Amulsar projects remains to be verified.

Looking some 10-20 years ahead, assuming that the copper price fluctuates around the current value and possibly recovers somewhat, and if no other external factors risk materialize, Kajaran could still contribute to the Armenian economy more or less as it does today. Teghut and Amulsar can potentially

add significant mineral worth. Teghut's reserves would ensure operation for several decades, but it is exposed to the same risks as Kajaran. Amulsar would, according to the current plans, operate for 10 years, after which the mine may or may not close depending on the definition of additional proven reserves.

The possibility to open additional mines, optimally including a more diverse set of minerals, is considered necessary for the sector to continue to be a main pillar of the economy in the longer term (+10 years). The above hinges on the discovery of new high class deposits, which is considered possible based on the geological foundation, the historical mining, and the fact that extensive exploration using modern methods has not been undertaken in Armenia. However, the opening of new medium-large sized mines in the near-medium term future (within some 10 years) is at the same time considered unlikely due to the low intensity of quality exploration, and bearing in mind general hit rates and time lines for exploration work (cf. Section 1.1).

Investors are drawn to a large extent by geological prospectivity, as exemplified by the large investments being made in countries with what is regarded as unstable and/or comparatively less attractive mining regulatory regimes. The best marketing possible are "success stories" that in themselves attract interest, and draw investors to the country. Despite Kajaran and Sungun (in Iran) showing the potential for large porphyry copper deposits in the Lesser Caucasus, well known international investors have not shown interest. This is likely to in part be due to the fact that there is little regional geological data of high quality accessible.

2.6. Recommendations

The Government's aspiration in terms of an overall structure for the mining sector (including for example numbers, size and type of mines) needs to be set at a policy level as a base for the implementation of regulatory mechanisms to ensure sustainable development in the desired direction. It is proposed that the future situation should be one where there are fewer mines and quarries but that these have larger production than today. Furthermore, the operations should be well managed and operate in an economically sustainable way with due care for the environment and human health and safety.

The collection of new geological data, and the subsequent marketing of these data assume vital importance to attract investment into exploration. The recommendations below are aimed at attracting investment into exploration.

- a. Collection of airborne geophysical data. This type of data is of fundamental importance to mineral exploration and the availability of this type of data is of very high interest to investors.
- b. Geological mapping at 1:50,000 scale. These types of maps do exist, but could be updated and improved through the use of modern equipment and mapping techniques. In this regard, the collection of airborne geophysical data is a prerequisite to quality geological mapping and more detailed geological maps would facilitate exploration. This could be coupled with geochemical surveys in selected regions.
- c. The implementation of an integrated geological data and information management system, housed at the Republican Geological Fund, SNCO. Such a system, based on spatial data, would facilitate the handling of data and information, and be a very useful tool for encouraging investments in exploration. Initially, the establishment of a policy defining data ownership, and rules and ways for disseminating data would need to be considered.

In parallel with the proposal above, MENR could consider to establish a promotion strategy for the Armenian mineral sector, in cooperation with the other relevant investment agencies. This may include publishing in international trade journals and generating promotional material for wider circulation;

planned presence at international mineral sector conferences and events; direct contact with targeted investors; production of monthly newsletters, etc. For a holistic strategy to take into account investors' positive perceptions, requirement/request for information, concerns etc., the formulation of the strategy would benefit from an initial survey of investors' perception of Armenia as a mining destination. It would be important to include current investors, past investors that have withdrawn, and potential investors. The survey should also include different sized companies, i.e. juniors and majors.

Concerning industrial minerals, it is recommended that a study is undertaken to establish specifications for different qualities of industrial minerals such as perlite, bentonite, diatomite, etc. and to assess the market demands for different specifications. This study should also look mineral processing requirement as well as the possible development of new down-stream industry. The proposed study should build on a concept paper on the processing of non-metallic minerals developed by the State Mineral Agency in 2013, which was approved by the Government while it has not yet been given any further action.

3. Stakeholder review

3.1. Government (national/regional and local)

On the national level the most relevant stakeholders are the Ministry of Energy and Natural Resources and the Ministry of Nature Protection. Other ministries that are potentially important include: Ministry of Agriculture, Ministry of Economy, Ministry of Finance, Ministry of Territorial Administration and Development, Ministry of Emergency Situations, Ministry of Health, and Ministry of Labour and Social Affairs.

The Marzpets (regional governors) are appointed by government decree and are therefore usually loyal to the President and the central government. Marzpets and their teams wield significantly more power than local self-government structures in the regions.

Communities are guaranteed self-governance through the Constitution. However, as most of Armenia's communities are small and financially non-viable, they are subsidized from the state budget, which creates dependency on (and loyalty to) central government. In addition to the state grants provided, the communities also receive some funds through: the collection of land and real estate taxes; certain types of state fees charged within the communities; state fees paid to local self-government bodies; and other revenues which, however, do not provide complete financial independence for the communities.

Though local self-governance bodies have the right to participate in the decision making process, practice has shown that local self-government institutional capacity and experience is deficient making them vulnerable to external, non-community influence. This, in turn, restricts the possibilities for local communities affected by mineral sector projects to participate in the decision making process.

3.2. Civil society, NGOs and CSOs

Civil society in Armenia, to the extent that it existed, was strongly controlled by the state during the Soviet Union. Since independence, there has been a rapid development of NGOs. In 2014 there were 3,981 NGOs registered, although it is unclear how many of these are active. Recent research puts the number at 500-800 (Paturyan & Gevorgyan, 2014). The US Agency for International Development has a CSO Sustainability Index, according to which Armenian civil society is 'partially developed'. Freedom House's Nations in Transit reported in 2014 that the Armenian civil society has remained at 3.5-3.75 on a scale of 1 (fully developed) to 7 (fully undeveloped).

Another aspect of civil society, independent of NGO activities, is social movements – groups of people united around a common cause, and there are several recent examples of such movements in Armenia, including protests during the summer 2015, which were triggered by the announcement of electricity price rises (the 'Electric Yerevan' movement).

According to some estimates, about a quarter of NGOs in Armenia claim to have been involved in environmental issues although the number of organizations specifically focused on the environment is much smaller, around two dozen. Most of them operate from the capital (Paturyan and Gevorgyan 2014).

Ecolur an environmental NGO positions itself as an informational NGO and maintains a website with wealth of environmentally related information in Armenian, Russian and English.

Transparency International – Armenia is an example of a non-environmental NGO that plays an important role in this area. It has published a number of reports, focusing mostly on the legislative and

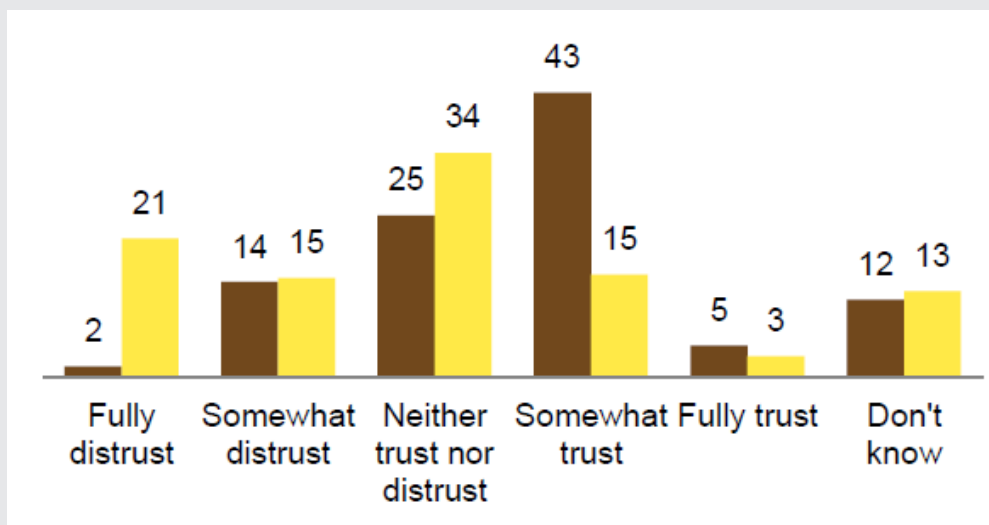
decision-making processes in the mining sector.

Some environmental NGOs are members of larger networks, such as the Environmental Education Network (Armenia-focused) or the Caucasus Environmental NGO Network (regional).

Surveys suggest that public trust in the work of NGOs is rather limited (see box below). The lack of trust is a serious issue as it limits the NGO's ability to act in a way which is beneficial to society overall (e.g. as watch dogs, encouraging public participation and deliberation, developing skills and capacities of the public and protector of possibly vulnerable communities).

BOX: NGOs and public trust in Armenia

In a survey, heads of Armenian NGOs were asked to estimate public trust towards NGOs. The comparison with public opinion data suggest that NGOs commonly overestimate the amount of trust that is placed with them.



The left-hand bar in each pair (brown) indicates NGO heads' perception of whether NGOs are fully distrusted, somewhat distrusted, etc. by the public. The right-hand bar in each pair (yellow) shows the actual public opinion. For example, 43% of heads of NGO believe that NGOs are somewhat trusted by the public, but in reality only 15% of the public somewhat trust NGOs.

Source: (Paturyan and Gevorgyan, 2014)

The relationship between the NGOs and the Armenian Government may best be characterised as cautious and cooperation is sporadic. For example, the Armenian version of the Ministry of Nature Protection website contains a section on cooperation with NGOs. That section is a list of names and contact information of around 40 environmental NGOs and some prominent human rights of general development NGOs. However, no further information on any specific type of cooperation is available.

3.3. Environmental movement

The environmental movement in Armenia has a several decades long story, spanning from the Soviet times. In late 1980s, the environmental movement formed and gained strength, by voicing popular concerns over pollution resulting from a number of chemical plants, and worries related to the operating nuclear power plant, as well as irresponsible mining. In the aftermath of a devastating earth-

quake in 1988, public fears led to shutting down the nuclear power plant – a move that later proved disastrous for the country’s energy. After that, the environmentalists acquired a poor reputation in the larger Armenian society. However, after being dormant for almost two decades, the environmental activism has re-emerged relatively recently. One cannot speak of a movement in a classical sense of the word; the number of people involved usually ranges between tens, or a few hundred at the most, that rally around a specific narrow goal (preserving a natural site, protesting a construction, etc.). These mini-movements usually describe themselves as “civic initiatives.” They are loosely organized and rely heavily on social media, where online presence and involvement usually outweighs “offline” actions. In fact, most of the publicly visible anti-mining sentiment is generated by such non-formal elements of the Armenian civil society; so called “civic initiatives” and mini-social movements.

Probably the most known and most long-lasting activist campaign against a mining project is the “Save Teghut” civic initiative (see box below). This initiative claims to have about 8,000 members online.

Box: Case Study - Save Teghut

The Save Teghut civic initiative represented the start of civic activism in Armenia. The stated concern of the initiative was one of wanting to preserve forest from being cut down to make room for the Vallex owned Teghut copper mine. The Teghut mine was permitted already in 2007, but mining did not start until 2014. Part of the delays were caused by civic action including: traditional picketing and protests; signing of petitions to government; organising activities and fairs where alternative livelihood were promoted (e.g. locally based honey and natural cosmetics businesses, and eco-tourism); participation in an initiative to apply to the Aarhus Convention, claiming that Armenia had violated two main principles, namely (public participation in decision-making, and access to justice in environmental issues); and organising a lawsuit, aiming to annul the government’s decisions. Additionally, in 2011, as the global financial crisis caused the Teghut project to be put on hold, Vallex started seeking funding from various sources, including from the Russian Vneshtorgbank (VTB) bank. Activists then started protesting outside banks, and particularly at the VTB bank, but also outside the Yerevan office of the EBRD. Social media has also been used, and the initiative has more than 8,000 followers on Facebook.

Save Teghut is now the most long lived civic initiative in Armenia. From the first days of its existence the ultimate objective has been to first stop, then close the mine and to have the permission of exploiting the forest declared as illegitimate. The initiative also made it clear that the declaration of the decision’s illegitimacy should entail relevant consequences, namely the prosecution of those responsible. While the Save Teghut civic initiative continues to pursue its ultimate purpose, the closure of the mine, it has showed flexibility in its objectives, as it now works to develop alternative, sustainable future livelihoods for villagers living near the operating mine.

Source: (Kankanyan 2015)

The Pan-Armenian Environmental Front was created in 2013. The same year they published a one-hour documentary on YouTube, called “Armenia’s Breaking Backbone.” The argument of the film is that current environmentally unfriendly exploitation of Armenia’s resources, particularly mining, is detrimental to Armenia’s future: it is an equivalent of breaking the backbone of the country. In December 2015, the Armenian version has been watched by more than 175,000 people, the one with English subtitles was watched about 5,000 times.

3.4. Bi- and multilateral agencies

There are a considerable number of agencies which do, or have done, significant work that include mining sector issues, including the following:

Organisation	Main interests/projects
OSCE	Environmental security, inventory and rehabilitation of old mine and waste sites
UNDP/UNEP	Application of the concept of “Economic Valuation of Ecosystem Services”
DFID	Promotion of responsible mining
USAID	Promotion of responsible mining, implementation of support projects for mining and geological data dissemination
World Bank	Support to mining sector reform and development
IFC	Investment in mining projects, notably the Amulsar project
GIZ and KfW	From the environmental and biodiversity perspective and possible conflicts with mining
EBRD	Investments in mining projects, including Amulsar, Teghut and the Deno gold mine.

3.5. Academia

The American University of Armenia has set up a Centre for Responsible Mining (AUA CRM in 2014), aimed at promoting global best practices in socially, environmentally, and economically responsible mining in Armenia and the region.

At the Yerevan State University (YSU), the Sustainable Development Centre was set up in 2012, with one of the aims being to address mineral exploitation, and to specifically focus on possibilities for safe management and possible reuse/reprocessing of waste. The Centre is housed in the important Faculty of Geology and Geography at YSU.

The National Academy of Sciences conducts research and coordinates activities in the fields of science and social sciences. This Academy has a Division of Natural Sciences, where research on the environmental impacts of, for example, mining has been conducted. The Academy also has a Division of Chemistry and Earth Sciences, which includes the Institute of Geological Sciences that performs geological and geophysical research activities, geological surveys, as well as seismology studies.

The National Polytechnic University of Armenia (NPUA) also provide important knowledge and training through its Faculty of Mining and Metallurgy.

3.6. Diaspora

The Diaspora is involved in the environmental issues in Armenia. For example, the Armenian Environmental Network was founded in 2007, and its aim is to facilitate information exchange between Armenia and the Diaspora (mainly targeting the US Diaspora). Its current biggest project in Armenia is on integrated waste management, including issues related to recycling and reuse, public education and participation, etc.

The Diaspora is also often perceived as an important source of investments in various projects.

3.7. Mining and exploration companies

The main part of the production from large and medium sized copper and gold mines globally is owned by rather few large and well known international mining companies, that usually operate several mines

in a number of countries, none of which are present in Armenia. The most important companies that operate metal mines in Armenia include:

- d. Cronimet Mining, the majority owner of ZCMC (operating the Kajaran mine), which is part of the larger Cronimet group, and which is a significant or even large international group of companies, albeit not involved in mining (apart from the Kajaran mine) but rather in the metal and scrap sector.
- e. Dundee Precious Ltd, is an international mining company listed in Canada, which runs the Shahunyan polymetallic mine, and which has operations in small number of other countries.
- f. GeoProMining, which is a Russian group that has one gold mine (Sotk) and one copper-molybdenum mine (Agarak) in Armenia, and which also operates a gold mine in Russia.
- g. The Armenian Vallex group of companies, which own the Teghut mine.

Armenia's largest copper mine (Kajaran) is about the 100th largest copper mine in the world, and the largest gold mine in Armenia (Sotk) fall outside a list of the 300 largest gold mines in the world.

Lydian International is not yet an active mining company, but it owns and promotes the Amulsar gold project. Lydian is registered in Jersey and listed on the London and Toronto stock exchanges. The remaining metal mining companies are small, and internationally unproven, and active only in Armenia, although they may have their company headquarters elsewhere. Connections with the political sphere are not uncommon. Further, many of these businesses are not really proper "mining companies", rather SME's that are active in mining and they may therefore have other needs/requirements/wishes compared to the larger operators.

The non metal sector comprises a large number of small and in a few cases, medium scale businesses.

There is no sector organisation, such as an Armenian Chamber of Mines. There is however an initiative called Armenian Mining Network that has been set up to provide the opportunity for "mineral resource professionals to increase communication and cooperation within the Armenian mineral resource industry."

3.8. Media

Television is the main source of information, but internet is catching up. According to the Caucasus Research Resources Centres – Armenia (CRRC), 79% of the population named TV as the most important source of information on current events and news in 2013. Internet was used by 17% of the population in 2013 compared to 6% in 2011. Thus, the figure has more than doubled.

Newspapers and radio have a marginal role, especially in the regions. Except for a few news outlets like Hetq and other online news agencies (CivilNet, Radio Liberty), journalism in Armenia often lacks professionalism. Overall, news reporting is reported to be shallow, data verification is poor, and self-censorship is often exercised (IREX, 2015).

With regards to mining, "Hetq" is the only investigative journalism outlet that is published online, and it reports on mining regularly. In 2008, the head of the Armenian Association of Investigative Journalists, who runs the Hetq, was attacked and severely injured by three unknown assailants. In the latest series before the attack this journalist exposed abuse and corruption in the Armenian mining industry.

3.9. Transparency

According to Transparency International's Corruption Perceptions Index (2015), Armenia ranks 95th out of 168 countries for perceived levels of public sector corruption, compared to Georgia's 48th placing

and Azerbaijan at 119. According to the World Bank Control of Corruption Indicator (2014), Armenia has a percentile rank of 40, meaning that it is more corrupt than 60% of countries assessed (a total of 215 countries analysed). The measured level of corruption has fluctuated in the past two decades, with no clear longer term trend.

Public opinion surveys in Armenia suggest that corruption is perceived as both a major problem and a fact of life, although public intolerance towards corruption is increasing (Paturyan & Jrbashyan, 2012). Data recorded in Caucasus Barometer (2013) show that trust towards various government structures is low, whereas the Armenian Apostolic Church and the National Army are well trusted.

3.10. Recommendations

The following recommendations are provided, which are all related to the particularities of the stakeholders in the Armenian minerals sector:

- a. Better opportunities for local community to take a more active part in planning, and to provide informed contributions in decision-making for how mines are developed and established should be created. Participation of local communities in decision-making is regulated by law (c.f. Chapter 4.7) and, for example, local communities are consulted during the EIA process and their opinions attached to the submitted mining rights application. Nevertheless, it is recommended that the capacity of communities is strengthened to facilitate improved participation and that the ability of CSO's to be a constructive party in such processes be encouraged. Probably, special training effort aimed at such NGOs may be necessary. This training could be provided in partnership between different stakeholders; both the mining companies and the State would have a responsibility for, and an interest in, strengthening community capacity and relations, and assistance can be sought from development partners.
- b. The different bi- and multilateral agencies involved in supporting the development of the mining sector, in one way or another, need to be internally well coordinated.
- c. The mining companies should be encouraged to form a business organisation, like an Armenian Chamber of Mines, the establishment of which should be initiated and financed through the mining companies themselves. As the companies have differing needs and requirements (e.g. since there is one big operator, a small number of medium scale, and a whole host of small businesses), such an organisation may need to have a special unit for SMEs. A Chamber of Mine would facilitate relations with government and discussions among stakeholders, and may also make it possible for Armenian mine operators to agree on important guidelines and criteria to improve business ethics and behaviour.
- d. Efforts should be made to attract established, responsible and well known international mining companies to invest in Armenia. Such operators may then bring international best practices with them, which can subsequently be spread throughout the sector.

4. Policy and legislation

4.1. Policy

The mining sector has received considerable attention from policy makers in recent years. A decade or so ago, mining policy issues were most intensely, and almost only, discussed and considered in any depth at the World Bank. Today, there are a number of ongoing policy development initiatives, both by newly set up institutions as well as by well - established organisations and/or think tanks such as the EU, the World Economic Forum, and the African Union who previously gave the mining sector more limited interest (see box).

Box: Policy initiatives for the Mining Sector

Before the millennium, in depth discussion on how to best develop, manage and control the mining sector in developing countries was almost solely discussed at the World Bank. The advice provided was based on free market reform, and to ensure that foreign investments were allowed to flow into exploration and mining development. With regards to exploration, it was recommended that rights should be issues on a “first come, first served” basis.

In the late 1990s, the World Bank Group had become increasingly concerned with the need to consider environmental and social issues in mining sector development. In fact, severe criticism of some World Bank projects and a debate over the “resource curse”, led to a review of the bank involvement in projects in the “extractive sector”. The “Extractive Industries review”, was completed in 2004 and it concluded that the proper development of extractive industries can contribute to poverty reduction and that World Bank involvement can positively influence industry standards. Since 2004, the World Bank has developed a comprehensive set of tools aimed at assisting in the proper development and control of all the links in the “mineral resource chain”. These tools have become tightly coupled with the Extractive Industries’ Transparency Initiative (EITI).

The EITI is a global Standard to promote open and accountable management of natural resources, which seeks to strengthen government and company systems, inform public debate, and enhance trust. In each implementing country, the EITI is supported by a coalition of government, companies and civil society working together. Countries implementing the EITI must annually report information on tax payments, licences, contracts, production and other key elements around resource extraction, which allows citizens to see how their country’s natural resources are being managed and how much revenue they are generating. At the end of 2015, there were 49 countries implementing the EITI, of which 31 had candidate status, and 18 had compliant status.

Following the latest commodity price boom, a number of new policy initiatives have been developed. In general, these either aim to ensure the future supply of metals (e.g. the EU’s raw materials initiative), or attempting to provide advice to resource rich countries of how to better ensure that benefits of the sector can be better harnessed. Some of the latter type of advice (e.g. the Natural Resource Charter) is suggesting that the mineral sector should be managed more like the oil sector, including public bidding for tenements, in contrast to “first come, first served” approach. Other development relates to attempts to formalise, better structure and even stipulate legal requirements for the CSR related activities that often are performed by international mining companies that operate in developing countries.

Most recently, policy initiatives aim to assist states to move from being solely exporter of raw materials to also being manufacturer and supplier of knowledge-based services, thus ensuring broad-based development through linkages to other industry. The need to ensure local development and community benefits are also highlighted, as are efforts to improve the capacity of nations to negotiate contracts with mining companies.

Policy related initiatives have been driven to a large extent by the needs of resource rich developing countries (rather than transition economies) and many developing countries have also reached far in implementing policy and law in line with advice that has emerged over the years. Whereas transition states have moved towards a market-based economy, the specifics of such states' regulatory systems and how they may need to be adapted to facilitate mining sector development have not attracted as much interest and policy debate.

Armenian policy, specific to mineral sector development, sets the agenda broadly, but there are no detailed policy goals or actions defined, nor a plan for policy implementation:

- a. According to Armenian Development Strategy (ADS) for the period 2014-2025, industry's contribution to the economy must continue to increase, and the mining sector with its downstream metals production sector are expected to be important contributors to that growth.
- b. A similar aspiration is expressed on the website of the Ministry of Energy and Natural Resources, which states that: "...the current state of affairs does not enable full use of the economic potential of the mines. Organization, in closed and complete cycles (from extraction to creation of a final product), of processing of metal minerals extracted in Armenia will provide opportunity to make high value products, which in its turn will ensure the GDP growth..."
- c. The current Government Program for 2012-2017 also strongly emphasises economic development, in part through industrial development including efforts to engage foreign firms and investors to introduce new technologies and increased knowledge. It also makes a reference to a balanced approach of ensuring environmental protection and specifically mentions strengthening environmental oversight of mining activities.

Nevertheless, some legal provisions and governmental actions provide concrete statements of policy directions considered to be important in promoting mineral sector development. Thus, Armenia committed to implementing the EITI standard in July 2015 and is now preparing a candidature application. From this follows that it is the Government's strategy to move towards accountability and transparency with regards to tax payments, and information on permits, contracts, and production, etc. and towards multi stakeholder participation in driving this strategy forward. Also, as described in more detail below, the enactment of a modern EIA law (2014) as well as provisions for exploration permits to be awarded on a first-come-first-served basis under the current RA Mining Code provide example of directions of policy development.

4.2. Introduction to the legal framework

The legal system of the Republic of Armenia emerged, and continues to evolve according to the pattern of civil law countries. Similar to the situation in some other transition countries, the Armenian legal system bears some influence on the former ideological and institutional rationale, and practices. The legal system as currently constructed is therefore a hybrid mix of old laws (some of which no longer have practical application) and new laws, which have been passed since independence.

International agreements become a constitutive part of the Armenian legal system when they are ratified or adopted by the relevant national authorities. Thus, according to the Constitution: "If a ratified international treaty stipulates norms other than those stipulated in the laws, the norms of the treaty shall prevail. International treaties contradicting Constitution cannot be ratified."

Primary legislation in Armenia usually covers both substantive and procedural aspects. In addition, while secondary regulations usually aim at implementing primary legislation, in Armenia they often deal with a few substantive issues too. The tendency is then towards extensive regulation by law.

This appears to be related to a “legal culture” where by entrusting the power to legislate and regulate mostly to the Legislative Power, it is sought to insulate the regime from frequent changes by the Executive Power and ensure the longer term stability of provisions. This approach necessarily entails frequent revision and amendment of the law (e.g. even to revise time periods for decision under the RA Mining Code), which negates stability of the legal regime.

Overall in the development of mineral law in Armenia, there appears to be insufficient focus on conceptual thinking prior to the legal development process, including the drafting of policy-making and developing concept papers, before the actual drafting of a law begins. It appears as if the drafting of law is in some cases an ad-hoc response to upcoming issues or ideas that require state action. Discussions at the policy level do not appear to consider various options by which problems can be resolved, such as, for instance, specific guidelines or wide public awareness campaigns. In this regard, there appears to be need for stronger coordination and cooperation between different ministries in legal development.

4.3. Mineral regulation

The RA Mining Code of Armenia has been amended a few times since independence, and additional amendments are now before the parliament (table 4.1). The version that came into force on 1 January 2012 is the main legal instrument currently governing the sector.

Table 4.1. History of the Armenian mining code.

Armenian Soviet Socialist Republic’s Mining Code	1976 - 1992
Armenian Mining Code (I)	1992 - 2002
Armenian Mining Code (II)	2002 - 2012; amended once in 2003
Armenian Mining Code (III)	2012 - present; amendments: 2012 December 19 2014 June 21 2014 December 17 2015 June 22 additional proposed amendments related to the calculation and utilization of reclamation fund payments.

The overall purpose of the RA Mining Code includes:

- Establishing the principles for conducting mining in all the territory of the Republic of Armenia;
- Governing relations derived from nature and environmental protection;
- Ensuring safety in works during mining; and
- Ensuring the protection of rights and legitimate interests of the State and individuals for conducting mining activities.

The RA Mining Code further defines the main spheres of law and regulation, and the underlying principles to include the following:

- Stating the principle of exclusive ownership of the State on the subsoil;
- Establishing a role for the State in developing ‘State programmes’, and preparing a State inventory of mineral reserves, as well as a regulatory role with an explicit focus on conducting ‘State expert examinations’ along the procedure for granting permits;
- Setting safety and environmental regulations, and regulations for a ‘reasonable utilization’ of mines;
- Setting forth transparency as a principle (defined under Article 9 as ‘dissemination of information regarding activities related to mining’ as establishes under RA laws’); and

Establishing the principle of ‘charging for the use of minerals’.

Similar to the subsoil law of some other transition countries, the RA Mining Code bear remnants of older legislation, in particular in the area of controlling mineral reserves and in reserves balance monitoring. Thus, the hard-minerals sections of previous sub-soil law in some transition countries were aimed at encouraging increased knowledge of minerals reserves and setting rules for State enterprises and entering into contracts to carry out the production of minerals from identified ore deposits. Rather than considering the minerals sector and the involvement of private actors in it as a catalyst for development, their main role was that of supplying the domestic resource-needs and supporting the economy in that way. These subsoil laws have later evolved to allow for corporate participation.

With regards to the role of the State, the RA Mining Code places emphasis on its role in:

- developing and implementing ‘State programmes’ on protection and integrated use of the subsoil at a national, regional or local level. State programmes refer to policy type documents approved by Government decisions, describing development plans and strategies on specific issues;
- preparing a State inventory of mineral reserves and balance calculation, and administration of registry system for exploration and mining permits, as well as for mineral deposits;
- setting the basis for State control and State expert examination (examination of accuracy of information on reserves being instrumental in the process of granting permits);
- developing State ‘standards’ in the field of mining and subsoil protection (the Code refers to standards, norms and regulations);
- establishing the basis for fees for the use of minerals.

Thus, the role envisaged for the State is as policy developer, while the lack of a comprehensive mineral policy is perhaps the most significant hindrance for the organized and stable development of the sector (cf. Section 5.1). The role of the State is also as administrator and regulator, with intervention along the process of granting permits through State expert examinations of the applicants plans and designs related to environmental requirements and technical safety as well as to approve reserves estimations and technical operation designs submitted by the applicant. The State, however, does not have a role as an entrepreneur, neither in legislation nor in practice.

Mineral rights regime

The most important function, and most focus, of a mining code commonly lies in the establishment a regime for allocating mineral rights – to set the rules and procedures for acquiring, maintaining, transferring and cancelling mineral rights. The RA Mining Code does establish such a regime in Articles 20-31.

The main legal aspects of the mineral rights regime are presented below, while the process for the application and granting of mineral rights is described in Chapter 6 in conjunction with a presentation of the institutions involved in this process.

The RA Mining Code applies to metallic and non-metallic minerals, as well as mineral water. It does, however, not regulate radioactive minerals or the exploration and extraction of oil and gas, both of which according to the Mining Code shall be subject to a separate law. There are no specific provisions applicable to industrial minerals in the RA Mining Code, apart for that legal persons and individuals are entitled to conduct extraction of non-metallic minerals that are not registered in the state mineral reserves balance for non-commercial purposes, up to a depth of 2 meters, without acquiring mineral right. Thus, most types of commercial mining (metals, non-metals, and different mine size) are regulated in the same way, which is in contrast to some mining countries in which for example small-scale mining and industrial mining is regulated differently to large scale metal mining in some regards (e.g. simplified permitting procedures).

The RA Mining Code establishes that the subsoil of the Republic of Armenia is the exclusive domain of the State and the Code provides for the granting of three types of mineral permits: (i): exploration agreement; (ii) exploration permit for the purpose of further extraction; and (iii) exploitation permit. The Code does not provide for any type of applicant priority for an ‘exploration permit’, while an ‘exploration permit for the purpose of further extraction’ is awarded on a first-come-first-served basis. The permit contents (e.g. exploration plan, permit coordinates, etc.) are similar for the two, while the explored mineral is specified in the permit form for the latter in contrast to the former. Thus, an exploration permit is issued for reconnaissance-type exploration work and, similar to the situation with ‘reconnaissance licenses’ in some countries, the Code does not preclude the issuing of more than one ‘exploration permit’ over a specific geographical area.

Mining codes usually define cases of ineligibility of certain persons to hold mining permits. This can include for example public officers, and some recent mining codes also exclude people with records of conviction for corruption or environmental damage cases. The Armenian Mining Code, however, does not provide for any type of ineligibility cases, but any legal person can apply for a mining permit (although the financial and technical capacity and means of any applicant needs to be approved by the authorities). If a mining permit held by a legal person has been terminated, a new mining permit is however not granted to such a person.

Exploration rights are issued for a time period of up to 3 years, which may be extended three consecutive times, each for a time period not exceeding 2 years. Mineral rights for extraction of minerals (mining rights) can be issued for the duration of the mine life, as per the approved technical plan, but up to a maximum of 50 years, after which an extension of the mineral right may be applied for.

The RA Mining Code also includes provisions for the expansion of subsoil allotments, relinquishing of rights, and for transition between exploration and exploitation permits. Thus, the Code provides for that: “a person granted with the right of geological exploration for the purpose of mining... has

a preference for acquiring mining rights on the subsoil allotments on which he collected geological information at its own cost'. Although we have been informed that there has not been discretion in granting mineral rights to applicants other than the holder of geological exploration rights, it would be important to establish a clear entitlement to mineral rights to strengthening security of tenure.

Box: The concept of 'Security of Tenure'

"In a narrow sense of the term, security of tenure relates to legal entitlement in the critical transition from discovery to mining. In the mining tenure sequence, the allocation of mineral rights upon a successful discovery will display a different set of solutions according to whether they should be automatically assigned to the discoverer, whether the discoverer should have priority regarding mining rights, or whether they should be allocated either to the discoverer or to any other applicant at the government's discretion.

It has been argued that legal entitlement to extraction rights constitutes a first phase of the concept. In a second phase, it involves the certainty of rights obtained and the conditions under which they may be revoked or lost in the exploration and mining phase, transferred or mortgaged. Following this broader interpretation of security of tenure, it has been stated that a regime of secured tenure ensures that a mineral right, once granted, cannot be suspended or revoked except on specified grounds which are clearly set out by law, and provides reasonable assurances guaranteeing the continuity of operations over the life of the project. An aspect encompassing the continuity of operations is related to the ability to transfer the title to eligible third parties, and to mortgage the title to raise finance." (Bastida, 2001).

Mineral rights are granted through a mineral permit, a 'land use permit act' (a document that defines the area of subsoil allotments), and a contract between MENR and the applicant. Contracts are envisaged for all three types of mineral rights and the RA Mining Code defines the contents of these. Furthermore, there is a Government decision from 22 March 2012, which establishes a mining contract model for 'geological exploration for the purposes of mining', and for 'exploitation/mining' (see box below).

Box: Contents of Armenian model mining contract

Main structure:

1. General Provisions
2. Subject of the Contract
3. Rights and Responsibilities of Parties
4. Caution
5. Reports and Information
6. Duration of the contract, date the contract enters into force, termination
7. Grounds for amending the contract
8. Force majeure
9. Dispute settlement
10. Notification
11. Other Provisions
12. Location of the parties, bank account details, signatures

Annexes:

1. Financial Proposals and Mineral Resource Fees
2. Responsibilities under Mine Closure Plan
3. Responsibilities for social-economic development of the communities
4. Environmental Management Plan

Geological exploration contract

The Geological Exploration Contract has a similar structure than the mining contract, except for a separate clause for the *duration of the contract*. As to the annexes, the Geological Exploration Contract requires only a *time schedule* for conducting geological exploration and submitting findings for State expert examination.

The contract is signed between the Ministry of Energy and Natural Resources and the Mining Company. In certain cases ad-hoc contractual clauses might be added setting special conditions.

4.4. Land access and eminent domain

Land relations for mining are subject to provisions of the RA Land Code and the RA Civil Code. Thus, land belongs to either the State, communities or is private property. In the case of State and community lands, relations are regulated through Government and local self-government bodies (community administration, regional administration/Marzpetaran) and land for mining are acquired through renting, servitude contracts, and purchase agreements. In the case of private property, the company can either directly buy, rent, or sign servitude agreements with private property owners (citizens, legal entities). The company initiates and runs the negotiations with private property owner without State's intervention.

The RA Land Code defines land use categories (Table 4.2), and land must be used strictly in accordance to its land use category. For mining to be allowed, the relevant piece of land must have been assigned to the category "Industrial, mining and for other production purposes". The Government can change the category of land into industrial for mining purposes, upon request by a mineral permit holder. However, existing regulations provide that in cases where there exists a community master plan, changing the land use purpose must be consistent with the master plan. For communities that

do not have such a master plan, and instead use temporary schemes, land use purpose changes are made based on the permission from the RA Government.

Table 4.2 Categories of land defined by the RA Land Code, and their main purpose for use.

Agricultural Lands	Cultivated lands; Long-term plantations; Hayfields; Pastures; Other soil types
Settlement/Residential	For residential building; For public buildings; For various/mixed buildings; For general use; Other lands
Industrial, mining and for other production purposes	Industrial purposes; Agricultural production purposes; Stocks; Lands allocated for subsoil use (mining)
Energy, transport, communications, communal infrastructures	Energy; Communication; Transport; Public infrastructure
Specially protected areas	Nature protection; Envisaged for medical purposes; Envisaged for leisure activities; Historical and cultural
Lands of special importance/purposes	Environmental; Envisaged for sanitary purposes; Envisaged for recreational activities; Historical and cultural
Forest land	Forests; Cultivated land; Hayfields; Pastures; Bushes; Other lands
Water	Rivers; Natural and artificial reservoirs, lakes; Areas separated for hydro-technical, water economy and other purposes needed for use and protection of water objects
Reserved Land	Lands belonging to the State, which are not transferred to communities, citizens and legal entities by property ownership or use rights; Lands banned from economic activities as a result of conservation; The Government manages State land reserves directly or through state authorized bodies.

According to the Constitution, expropriation of property may be carried out in exceptional cases of paramount public interest only, and prior adequate compensation. The Law on Expropriation of Property for the Needs of Society and the State (2006) sets the principles and grounds based on which property can be expropriated, mining being explicitly listed among them. The law, furthermore, instructs the Government to make decisions on expropriation, and specific decisions are taken on a case-by-case basis. Expropriation of property for mining purposes have been grounded on the following "common" justifications:

- The project holds national importance in the field of mining;
- The operation of the project will provide a substantial increase in the volume of industrial output and exports of Armenia;
- The implementation of the project will significantly contribute to strengthening the economic security of the country; and
- The mining project will substantially trigger a region's socio-economic development.

Property holders can apply to courts when having disagreements or claims related to the decision of expropriation. The property holder has the right to appeal the decision in Courts. Prior compensation of the expropriated property is calculated on the basis of a price, which is 15% higher than the market value (the determination of the market value of real estate and property rights being set under the procedure established by the Law on Real Estate Evaluation Activity). The State Cadastre Committee is also involved in assessment of land.

The law thus provides for a clear process to assign and access land for mining with "straight-forward" negotiations between companies and landowners, and governmental decisions around expropriation and compensation, when the situation so demands. The process however lacks some of the concepts

that today are often considered internationally in cases of compensation and resettlement (see box below).

There are currently court cases held against Armenia at the European Court of Human Rights (ECHR) on the grounds of unfair compensation for alienated property (from Teghut and Shnogh communities, Lori region): Mashinyan and Ramazyan v. Armenia (Application no. 65124/09), Parsadanyan and others v. Armenia (Application no. 5444/10), Osmanyanyan and Amiraghyan v. Armenia (Application no. 71306/11). Along with compensation issues, the cases question the "fair balance" between the demands of the general interest of society and the requirements of the protection of the individual's fundamental rights. The ECHR has not passed decisions over these cases as yet.

Box: International trends on compensation for use and expropriation of land

Mining laws and contracts, as well as codes of conduct of companies, banks and financial corporations, are adopting far higher standards than in the past to engage with, and compensate landowners and landholders for the use of their land for mining operations. In some cases, guidance for consultation, negotiation and compensation are provided through guidelines documents made available online. An important point is that these standards are not only applicable to landowners, but also to landholders: those living in plots of land but not holding formal titles.

A good practice reference is the Performance Standards prepared by the International Financial Corporation (IFC) for financing projects in which they are involved. While the question of resettlement is very controversial, Performance Standard 5 on Land Acquisition and Involuntary Resettlement sets guidelines that can be helpful, analogically, when fair compensation criteria is needed (for example, for establishing the basis for compensation for "economic displacement" caused by land acquisitions or restrictions on land use (regardless whether affected people are physically displaced)).

The IFC Performance Standards require full replacement cost for loss of assets of economically displaced persons, and, in case the livelihoods or income levels of those persons are adversely affected, it is established that opportunities to improve, or at least restore, their means of income-earning capacity, production levels, and standards of living, must be provided.

4.5. Environmental and social regulations

Basic features and provisions

Environmental and social regulation of the mineral sector is primarily based on the RA Law on Environmental Impact Assessment and Expert Examination, 2014 (EIA Law) and the RA Mining Code, 2012; the latter amended in 2014 to be "harmonized" with the former. The inclusion of environmental and social provisions in the RA Mining Code is in line with modern mining law development, while it requires strict alignment with other legislation, not to add complexity and confusion around requirements and implementation responsibilities.

Overall, the legal framework, and in particular the EIA Law, is sophisticated and includes most, if not all, concepts and methods that one may wish to see in that the goal being to anticipate, prevent or mitigate potential negative impacts on the environment or human health and well-being. Key principles guiding the preparation of assessments and expert examinations are in line with the concepts of sustainable development. There is, however, a lack of some important pieces of secondary legislation and/or guidelines to aid implementation of the law, for example proper guidelines or methodologies for assessing impact on human health and similar methodologies for assessing impact on biodiversity. This might partly be due to the fact that the EIA Law itself was enacted recently.

General provisions of relevance in the RA Mining Code include that a mining project proponent or operator must undertake measures for: protection of the environment, water basins, soil, fauna and flora; and respecting the regime of special protected national parks. The mine operator must reclaim land, and manage waste adequately and overall observe and abide by the provisions on expert examination of the environmental impact assessment. The Code refers to other law, including the EIA Law, for further regulation.

The EIA Law classifies types of planned activities into three categories (A, B and C) based on descending scale and impact on the environment and with different assessment procedures for each category. All mining projects are classified as Category A. In addition to defining general EIA principles and procedures, the EIA Law also introduces the concept of strategic assessment, and defines activities subject to strategic assessment (mining is included within the activities subject to strategic assessment). The Law defines strategic assessment as the process of evaluating the possible total and cumulative impact of the proposed project. Other special assessments include economic assessment of environmental damage, assessment of ecosystem services as well as assessment of financial compensation for environmental damage and liability. Methodologies and guidelines for these assessments are however still in the process of development.

The EIA law also has provisions on transboundary impact assessment, including expert examination and international cooperation, in accordance with the Convention on Environmental Impact Assessment in a Transboundary Context which was ratified by Armenia in 1996.

Inspections to assess compliance with environmental regulations are carried out once per 1-3 years. If complaints are made (by nearby communities, NGOs or other organizations), additional inspections may be conducted. Mining companies are as yet not obliged to carry-out self-monitoring.

Social aspects

Social impact assessment is part of the requirements of the RA Mining Code and EIA law. The requirements are to include provisions to improve the local population's social conditions, livelihoods and to guarantee participation in decisions regarding socio economic development initiatives for the communities. To our knowledge, this has so far only been "tested" within the EIA process Lydian International's Amulsar gold project.

Mining contracts also should include such local socio-economic development related provisions. In the absence of more detailed regulations, mining contracts can have an important role in bridging gaps in existing regulations, adopting and aligning with best international environmental and social practice and enhancing clarity and coordination of the roles of different government authorities with competence in areas relevant to the mining project.

Box: Should community development requirement be included in law?

More than 30 countries have adopted community development requirements into their mining laws. This approach to addressing mining's impact goes beyond mitigating the negative effect of mining on local communities (such as through compensation arrangements and environmental laws), to requiring firms and/or states to ensure that mining translates into positive social and economic gains for mining-affected communities, thereby attempting to redress cases of inequitable distribution of mining's costs and benefits.

Nearly all the countries with these types of legislation in place are developing countries. A notable exception being some provinces in Canada, where Community Development Agreements are required between companies, and local communities when the projects are impacting upon land used/owned by indigenous/first nation communities.

Source: Dupuy, 2014

Specially protected areas

Provisions that set lands banned from mining are scattered along the text of the RA Mining Code. Thus, mining is not allowed in the areas of cemeteries; natural, historical and cultural sites; sites with fauna or flora registered in the Red Book of the RA, or which are migration routes for species.

Specially protected areas (cf. table 4.2), are divided into several categories: natural reserves; national parks; state wilderness areas; and state natural monuments. Each of these categories have a specific protection and a management regime, and a list of activities prohibited within their boundaries. Geological exploration, mining and ore processing operations are not allowed in nature reserves and national parks. It is, however, allowed to conduct mining, without the use of explosives, within defined economic zones of national parks.

Mining is also prohibited in other types of specially protected areas including land for medical/sanitary purposes; for leisure/recreation, and; lands of historical and cultural value, that have significant aesthetic, scientific, historical, cultural, recreational, sanitary environmental/nature protection values. Each type of such lands is managed through special legal regimes. These type of lands can be fully or partially removed from economic or citizen use based on decisions by government, ministries, and local self-governing bodies. The law also prohibits expropriation of nature protection lands for purposes that do not correspond to their defined use and operational purpose, while land use categories can be changed upon Government decisions (cf. Section 4.1).

Mine closure

The application for the mining or extraction right must include a mine closure plan, which should be part of the mining contract, and cover the following: dismantling of infrastructure, machinery, equipment and buildings, land reclamation plan, workforce social mitigation plan, a monitoring plan; final closure plan to be approved 2 years before the planned end of operations. With regards to the last point, it commendably aims at ensuring a timely design of the mine closure plan, while in best practise management, an adequate mine closure plan should exist at any point in time of the operations (cf. Section 7.2).

BOX: Mine closure standards

Comparative mine closure regimes have evolved substantially in the last few decades. The focus is generally placed on the need for environmental clean-up and rehabilitation, with increasingly stringent standards of financial assurances and relinquishment criteria. Socio-economic aspects are usually not reflected in legislation. Water security and climate change are emerging issues likely to influence the development of future mine closure regimes. Across jurisdictions, international standards play an important role in the development of law and regulation. Overall, best practice for mine closure requires early planning, integration of closure plans throughout all phases of mining and through post-closure; progressive reclamation provisions; financial assurances.

A World Bank report that analyses mine closure regulations in Armenia (2014) notes that “even though this approach of reviewing the whole “cradle-to- grave” process of mining development is in line with all international standards, it leaves a lot of questions and issues that could arise in the practical implementation, mostly related to planning of financing mine closure, and the responsibilities and liabilities and associated with post-closure monitoring.”

Environmental fees and guarantees

The RA Mining Code lists a range of fees, termed mineral fees (or subsoil use fees), which have a bearing on environmental management, and which are further regulated under other laws. These fees, in the wording of the English version of the RA Mining Code, include:

- a. environmental fee for implementing environment protection measures,
- b. contributions to nature and environmental protection fund (reclamation), for restoration of lands damaged by mining activities (*note: referred to as Environmental Protection Fund in other Armenian legislation*),
- c. fee for monitoring of the program, ensuring safety and health of people in the areas of mining, and disposal and storage of industrial waste,
- d. fee for use of minerals, (except metallic), use of minerals deemed as state property,
- e. royalty for metallic minerals, use of minerals deemed as state property,

The ‘environmental fee’ (paragraph 41a), relates to provisions in the RA Law on Environmental and Natural Resource Use Fees (in force since 1999), which define three types of ‘environmental payments’ that apply to both metal and non-metal mining, and include:

- a. Payments for emission of hazardous substances into the environment (air and water)
- b. Payments for disposal of industrial and consumption wastes into the environment
- c. Payments for products causing harm to the environment

The rates as well as calculation mechanisms for these payments are regulated in accordance with the RA Law on Rates of Environmental Payments (2007). Furthermore, the RA Law on Targeted Use of Environmental Charges Paid by the Companies (2002) allows for a part of the environmental fees paid by the companies to be taken from the state budget and directed into the budgets of the affected communities where those companies operate. The list of companies and the amount of the subsidies are approved each year in accordance with the RA Law on Budget. The level of payment is based on the amount and nature of pollutants generated, and communities can apply for funds for environmental projects that they design. The law thus provides for mining companies to finance environmental and health protection measures, which are implemented by the communities. This mechanism for

environmental management is rather unusual, and there is a risk that it may to some extent lower the incitement for the companies to be directly involved and assume their share of the responsibility for community health and well-being. Furthermore, centralized decision making may not be the most efficient way to administrate and manage the fund, and key informants also mention that most of the funds are used for other priorities than environmental and health management.

Related to the provision referred to in paragraph 41b above, the RA Mining Code also makes specific provision for the inclusion of a financial guarantee for the implementation of the mine closure plan. This is related to provisions of the RA EIA Law for the assessment of costs for reclamation and mine closure and the levels of payments to the Environmental Protection Fund. Payments are regulated through Government Decision N 1079 on Calculation of Reclamation Funds. The preliminary payment is made after the contract is signed, and the amount should not be less than 15% of the total estimated amount. Subsequent annual payments are calculated from the outstanding part of the total estimated cost, and the time period for planned reclamation activities. This presents a problem as the system does not ensure that there are sufficient funds for complete reclamation and closure at any point in time, which is one of the most important aspects of modern mine reclamation and closure policy. There are also no provisions accounting for the possibility of changing monetary value over time, e.g. through exchange rate fluctuations or inflation.

At the end of 2015, the Nature Protection and Reclamation Fund represents about USD2 million. There is, furthermore, a draft amendment to the Mining Code that provides for the reallocation of funds from the Nature Protection and Reclamation Fund towards environmental and reclamation activities at abandoned and illegally exploited mines.

The ‘monitoring fee’ (ref paragraph 41c) is aimed at ensuring safety and health of people in the areas of mining, and the areas of disposal and storage of industrial waste. This type of fee is specified in the Mining Code as mineral/subsoil use fee. When applying for a mining permit, there is a requirement that the applicant/operator should present a detailed monitoring plan for mine closure. The amount of the monitoring fee and the calculation procedures are defined by the RA Government. The monitoring fee is paid by mining companies to the state, which should later be used by nature protection institutions to conduct monitoring, after mine closure.

The ‘mineral use fees’ referred to in paragraphs 41d and 41e above also relate to provisions under the RA Law on Environmental and Natural Resource Use Fees. Thus, mineral resource use fees are related to mining of hard minerals except for metal minerals, exhausted reserves; extracted reserves of underground portable and mineral water; and salt (41d), and royalty (41e) is paid for the use of metallic minerals. The rates and calculation mechanisms for natural resource use fees for non-metallic minerals are defined by the Government. For metallic minerals, the royalty rates and calculation methodologies are defined in the Law on Environmental and Natural Resource Use Fees.

4.6. Mine waste regulation

The RA Mining Code includes broad provisions on mine waste management in that it requires the operator to “ensure processing, assessing, eliminating and minimizing mine waste”, and that it should “adhere to norms and rules on waste collection, transportation, preservation, processing, and burying”. For further regulation, it refers to the Law on Waste, which was most recently amended in 2015, and which has as the main objective to define the key principles for a State policy on waste management (including mining waste) to establish main conditions, requirements and rules for environmentally safe waste management, to ensure minimal waste disposal and their utilization in economic activities, and to minimize the hazardous impact of waste on human health and the environment. As mentioned above, the RA Mining Code also requires companies to produce a mine closure plan, and

this plan should include a waste monitoring plan, among other things. In addition, the RA Law on Environmental Impact Assessment and Expert Examination is of relevance to mine waste management (see Section 7.1).

While the RA Law on Waste and the RA Mining Code were amended in 2015 to include some terminology on mine waste (e.g. definitions of mine waste, tailings and overburden), and thus acknowledging that it needs special consideration, both laws referred to above are of general nature, and there are no detailed mine waste management regulations. Thus, there are, for example, no specific evaluation criteria for environmental performance (e.g. seepage quality) and definition of hazardous mining waste, nor for factors of safety against dam wall failure and other aspects that help to minimise physical stability risks. There is also no specification of minimum technical safety monitoring, inspection and auditing requirements specific to mining waste facilities.

The RA Law on Rates of Environmental Fees (mentioned above) defines rates specifically for the disposal of industrial waste, with rates being based on the “degree of danger” and the type of waste. The law, however, provides for the exclusion of this type of fee for non-hazardous waste produced by mine operators and, in reality, such a fee is not paid for mining waste rock or mine tailings. One of the reasons for the exclusion of environmental fees on mine waste could be that it can be considered as a resource (see next paragraph), subject to later processing, but it is also noticed that applying a fee or a tax to mine waste disposal is highly unusual (see further section 8.3).

The RA Mining Code also introduces the term “man-made mine”, defined as an accumulation of minerals on the earth surface or in rock holes or tailings facilities formed as a result of exploration, extraction, processing and enrichment of minerals, which in compliance with the established regulations have received geological and economical assessment. Thus, according to law, non-operational tailings facilities, for which geological and economic studies prove a mineral reserve (ie. they may be economically feasible to mine) are classified as mines, rather than mine waste. These man-made mines are the exclusive property of RA and may be granted for extraction of minerals. The issue of “man-made mines” is discussed in detail in Chapter 8.

4.7. Public participation and access to data

The right for the public to participate in environmental decision making and to access data is protected in Armenian law. Thus, the Constitution places duties upon public officials in that these are responsible if found to be hiding information on environmental issues, or in denying access to such data. Furthermore, the Law of the Republic of Armenia on Freedom of Information includes provision to ensure public access to information, including procedures for requesting and receiving information and follow-up steps if access to information is denied.

The EIA law, furthermore, strengthens the right for public participation substantially. Thus, it states that the comments and recommendations of participants of the EIA process should be taken into account. Certain provisions to promote public participation and consultation on environmental issues have also been incorporated into local legislation to meet international best standards under Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters ratified by Armenia in 2001. With regards to early public notification, the EIA law ensures involvement of the public already when the developer submits an application to the Ministry of Nature Protection. Procedures on public discussions and consultations are established by Government decision (N 1325-N, 19 November, 2014). In order to ensure that the final EIA decision is publicly available, the law establishes a clear requirement to publish it on the official website of the Ministry of Nature Protection of RA within 7 days after the decision is taken. The regime of Specially Protected Areas also guarantees public participation in the management of such areas.

With regards to access to geological and mining information, the RA Mining Code provides that geological exploration rights and mining rights are registered in a centralized register of mineral rights administered by the Mining Granting Agency (Chapter 6) and that information from the register will be dealt with in accordance with the RA Mining Code and the RA Law of the Republic of Armenia on Freedom of Information.

Based on interviews held within this project, it appears as if general geological information, and information on deposits that are not covered by mineral rights (some 1,488 reports) is open and accessible to the public, upon request. Information related to mineral rights, however, appears to be only partly accessible. Mineral rights permits, as well as summaries of information on deposits can be accessed in the official websites of MNP and MENR. There is, however, no systematic practice on the publication of contracts and license information in Armenia, and mining and exploration contracts, operational information, and production and reserves information are not published on the grounds of commercial information confidentiality. However, this is likely to change in the future with Armenia joining the EITI (box below; also cf. section 4.1).

Notwithstanding legal guarantees to ensure access to information, the implementation of the law providing for public participation and data access faces many obstacles in practice, particularly as documents involving environmental information are not often provided by the ministries upon request, under the argument that they contain commercial secrets. Though the legal and regulatory guarantees are in place, there are still enforcement issues as it comes to ensuring public participation in the environmental decision-making process (cf. socio-economic considerations under section 7.1). Civil society should be the driving force in this respect, although it is within state's responsibility to ensure awareness, proper consultation, and involvement of the public in the decision-making process as well as addressing claims and violations.

Box: Trend towards contracts transparency

The terms of contracts entered between States and companies in the mining and the oil and gas sectors have traditionally been protected under confidentiality clauses. In recent years, with increased emphasis on the role of transparency in better governance and enhanced decision-making processes and broader interest from civil society on the environmental, social and economic impacts of projects in these sectors, there is a discernible trend towards contracts transparency, with more countries making them available on government websites. The EITI Standard (2013) requires that EITI reports describes the government stand on contracts disclosure. This trend is part and parcel of a broader move towards open processes of decision-making and strengthening accountability.

Key sources: EITI Standard (2013); a collection of contracts at ResourceContracts.org; and, more broadly, the Open Government Partnership <http://www.opengovpartnership.org>

4.8. Recommendations

It is proposed that a holistic policy for the sustainable development of the mineral sector is drafted. The development of the policy would provide a starting point for broader cooperation/interaction between institutions, as well as among civil society and private companies. The policy should, in addition to identifying what the future mining sector should be like, also identify the means and measures (technical, financial, human resources) necessary for achieving this vision. Basic questions that should be addressed include which type of mines (commodity, size, ownership, etc.) can meaningfully contribute to sustainable development goals; what economic development (national, regional, local) related to mining shall be promoted; what shall be the roles and responsibilities of the state and the

companies and their owners; and ‘ineligibility’ criteria for holding mineral permits.

The Mineral Policy development can serve as a starting point for a review and further development of the legal framework, where development of secondary legislation is of particular importance. In this regard, many jurisdictions use a set of instruments such as guidelines that do not have a legal binding status but provide guidance for actors in the preparation of documentation required by regulations (e.g. EIAs, mine closure plans, community consultations, tailings management, etc.). These can be amended upon further experience in implementation and can ultimately serve as sources for ‘tried and tested’ regulations at a later stage. This technique could be used in Armenia, with the goal to assist in the implementation of laws and regulations and in bringing in a set of ‘best practice’ international standards both in laws, regulations and in model contracts.

It will be important to continue activities towards EITI implementation. Thus, to make data available will assist to meet stakeholder demand for information and overall be useful for the EITI process. The EITI process can do this and that, and it will also contribute to the “increase awareness among the public at large”, which needs to be a longer term for policy development.

On the part of government authorities, the legal system has over-ambitious and descriptive terms for decision-making, which makes processes complex and implementation difficult. On the part of investors and other stakeholders, the legal framework is difficult to grasp and comprehend, and thus to adhere to. The drafting of a mineral policy needs to take this fact into consideration. In line with this, the development of a Road Map to guide mineral sector investors should be considered. The road map would assist would be investors to understand and abide by relevant legislation, application processes, and institutional set ups. The road map could be developed in a process that involves all relevant authorities and agencies as well as private sector, and be performed after the Mineral Policy has been established. Not only will this process end up with a useful product, but the process itself would contribute to a better understanding by all relevant parties of the needs, requirements and challenges experienced by the mineral sector.

It is not uncommon internationally that mineral and environmental legislation provides for different requirements for different types of mining (commodities and scale of operation). This is not the case in Armenia and should therefore be considered, initially by considering separate regulatory regimes for the metals and industrial mineral mining sectors.

Despite the apparent sophistication of the legal framework, there are significant gaps in rules and regulations, a lack of mechanisms for genuine inclusion and benefits for affected communities. The overall system should align closer with international standards on good governance in relation to environmental and social issues. This can be achieved through expanding and strengthening regulations for the preparation of Social Impact Assessments, and through references and incorporation in the legislation of model contracts, regulations and guidelines. Community Development Agreements could be considered, as a way in which companies and communities agree on issues related to local development, although these need to be consistent with an overall policy vision of the mining sector and its role in broader-based development.

With regards to resettlement and associated possibilities for compensating peoples (landowners and land users) that are affected by mining projects, there is a need to develop legal provisions in line with international best practice. In this work, there is a need to ensure that mineral sector legislation is well streamlined with legislation that governs land holding, and expropriation related issues.

The system for payments financial guarantees into the Nature Protection and Reclamation Fund needs to be revised so that mine-specific funds are tied to closure costs at any point in time of the operation of the mine, and also to include mechanisms to ensure that the value of the fund does not deflate due to factors such as inflation (c.f. section 7.5). It is noted that a draft Governmental Decision aimed at

addressing these issues, and in particular issues with the calculation of reclamation funds and fees for post-closure monitoring (also considering inflation factors), is being discussed among stakeholders. A simplification of the process for reclaiming of funds by operators is also suggested by the draft.

In order to enhance the role that law, regulations and contracts could play in advancing the contribution of the mining sector to sustainable development, the following actions should also be considered:

- a. There is a need to strengthening security of tenure (to establish clear legal entitlement for the transferring of geological exploration rights to mining rights).
- b. Mining contracts can have an important role in bridging gaps in existing regulations, adopting and aligning with best international environmental and social practice and enhancing clarity and coordination of the roles of different government authorities with competence in areas relevant to the mining project. The Model Mining Contract could further on this role, and set a basis for clarifying and strengthening coordination between MENR and MNP. Contracts should be published (in line with the current Law on Access to Information, the transparency principle set out under the RA Mining Code and international practice, and the pursuance of the EITI application).
- c. It is recommended considering introducing main rules, now established under the RA Land Code, in the RA Mining Code, and to complement those by establishing and strengthening compensation provisions, including those applicable to landholders, and including best international standards for cases of resettlement.
- d. It is proposed that that the interface between lands banned from mining in land legislation and the RA Mining Code is streamlined, to clarify on the territory open to mining.

5. Institutions and regulatory processes

5.1. Overview of institutions, responsibilities and regulatory work

The Ministry of Energy and Mineral Resources (MENR) is responsible for essentially all aspects of mineral sector administration and regulation, and mineral sector policy development. Most of the offices within MENR are generic to governmental ministries, while 5 offices are directly involved with sector management, described below.

The Mining Department is responsible for reviewing and drafting policy and legislation, and other documents of strategic importance to the mineral sector.

The Mining Granting Agency (MGA) was established in 2012 (through the 2012 RA Mining Code) with the aim to simplify the permitting process through a single contact and communications point for applicants (the “one window system” of the 2012 RA Mining Code). Thus, the MGA administrates the entire mineral permitting process and reviews expert examinations undertaken by three different authorities (see below: MRA, EEC & MoTAES), and recommends the granting or not of permits to the minister. There is no mining cadastre system at the MGA but permit information is kept in MS Excel sheets. The MGA has some 15 staff and they receive a total of some 20-30 mining and 20-30 exploration applications per year. The large majority of these are for non-metallic minerals.

The Mineral Resources Agency (MRA) is responsible for reviewing and approval of reserves estimations (reserves expert examination). This function has been with the ministry since 2002, and over time, the MRA has become a separate agency attached to the MENR. After the completion of the 3-year exploration permit period, reserves estimations must be submitted to the MRA even if a mining permit is not applied for. The MRA assesses the reserves calculations, including methodological and technical aspects of the calculations. Before deposit estimates are provided to the MRA, the license holder must subject 5% of the samples on which the reserves estimations are based to control analysis at the CJSC Analytical Laboratories. This is to ensure the accuracy of mineral quantities and qualities. Once approved, the reserves are registered with the Republican Geological Fund (see below). In accordance with the RA Mining Code, companies should update reserves estimates every 5 years and submit to MRA.

Apart from the geological assessment of reserves, an economic “cost-benefit” assessment is also conducted with a view to ensure that the exploitation will be economically beneficial (metal prices, fiscal regime, royalty and other relevant tax rates are taken into consideration when doing cost-benefit analysis). Environmental costs (reclamation and mine-closure) are not included in this assessment. Key informants, however, mean that this assessment is must be looked upon as preliminary as it is not based on a full mine plan. A final geological and economic assessment should, however, be submitted to the MGA at the time of a mining permit application. There is some 9 staff at MRA, and this is regarded by the MRA to be sufficient as they do not get that many applications.

The State Mining Inspectorate (SMI) controls that exploration and mining is undertaken in line with the contracts regarding various operational aspects and data reporting, and much focus appears to be placed on production rates and remaining reserves (often referred to as mineral balance). The SMI also reports on production rates to the tax authorities for the calculation of the natural resource use fee, including royalty on metallic minerals (cf. section 4.5, Environmental Fees and Guarantees).

The regulatory basis for inspections is the Law on Inspections and there is a Governmental decision providing the method for selecting mines for inspection. Thus, based on quarterly and annual “self-monitoring reports” submitted by the companies, mines are classified into high, medium and low risk for non-compliance based on a comparison of their reported production and reserves and what is

stipulated in the contract. About 20% of all mines are inspected each year, which translates into some 100-120 mines each year, and 70% of these are high risk, 25% medium and 5% low risk.

Physical on-site inspections are undertaken in accordance with a predesigned questionnaire (separate for exploration and mining inspections) and a 5-days notification is given. In the case of non-compliance, the company is notified, and is given 90 days to implement corrective action, unless they can satisfactorily justify the non-compliance. A non-compliance fine of USD100-300 can be issued in accordance with the Law on Administrative Violations, and the MSI can furthermore request the MENR to annul the mining contract if appropriate corrective action is not taken. According to the SMI, over the last year, 2-3 non-metal mines contracts have been annulled, a total some USD4,000 were paid in fines, and some 17 companies were taken to court. The main types of non-compliances are failure to meet the production rates stipulated by the contract, and incomplete reporting.

Prior to 2009, all inspections were undertaken by an inspectorate under the MNP, which then was split into the SMI under MENR and the environmental inspectorate under the MNP. The SMI has a total 38 staff under four divisions and four regional centres.

The Republican Geological Fund, SNCO (RGF) is essentially a repository for historical geological data and information; exploration and mining company reports; minerals reserves data compilations, and; exploration and mining contracts. Geological investigations undertaken during and before the time of the Soviet Republic (since the 19th century) has resulted in that significant amounts of data and information is now held and managed by the RGF. This information includes regional geological investigations and so called mine reports. Mine reports describe individual mineral deposits and can be extensive (e.g. several hundred pages, and including maps) and there are some 1,200 such reports.

All information is today stored in hardcopy. In part due to a lack of a proper storage environment for document preservations, steps are taken towards digitization of the materials held by the RGF. The USAID provides assistance in this area, and the RGF are currently producing so called mineral deposit passports; summary mine reports of at least 12 pages, which have been digitized and posted on the MENR homepage.

The RGF is mainly responsible for storing data and information, and providing access upon request (see below). Furthermore, they are charged with amalgamating reserves data (from exploration project reserves, verified by the MRA and annual company reports on production and remaining reserves data) to annually produce national mineral reserves balance sheets (see box below).

There are 14 staff at the RGF, and numbers and staff qualifications are considered to be adequate considering that highly qualified staff is not needed for the current tasks of mainly storing of information. The environment for storing documents, however, needs to be improved to ensure their longer term preservation. Also, capacity building is likely to be needed if/when data and information is digitized, and stored and handled electronically.

Box: Why the use of national mineral balances?

In Armenia, the authorities record deposits' initial reserves and update these on a yearly basis to keep track of the remaining reserve (the balance) after the extraction of a certain amount of ore. This is monitored for individual mines, but the data is also amalgamated to produce national mineral balances – i.e. data on total production and remaining reserves in Armenia for individual commodities. The rationale for this practise is apparently that balance data is necessary for the State to develop short- and long-term socio-economic programs and, in general, for the development of economic and industrial policies.

Knowing the amount of reserves for individual deposit is of interest to inform and attract potential investors. Furthermore, it may be of interest for the authorities (and not only to the company) to be informed about the medium- / long-term outlook for individual operating mines in terms of their level and nature of operation, which could have a bearing on economic and socioeconomic development programs. However, the usefulness of a national minerals balance for strategic planning is questionable for at least four main reasons:

First and foremost because it fits poorly into a liberalised economy, where the state has no role as a mineral producer. In such a liberal economic system, the state's role is one of regulating the activities in question, and in ensuring that the private sector abides by laws, regulations and agreements made.

Second, because it is questionable that credible data for a national balance can be established at all. This in turn follows as true national reserves are always unknown, as exploration is merely scratching the surface of the Earth, and also are conducted in a very limited geographical space. Furthermore, whether or not reserves are economic and amenable for extraction is subject to a range of factors, and thus highly uncertain to predict.

Third, the reserves that are form part of the national Armenian balance today were to a great extent established in the past when methods and evaluation techniques were inferior to the ones that are in use today.

Fourth, and finally, there are no provisions in policy or legislation for how the mineral reserves balances information should be used, and there is also no policy document stating the purpose of attempting to keep track of the national reserves balance for individual minerals.

In conclusion, the Armenian state could reconsider its concern with keeping track of mineral reserves. This type of work is commonly the concern of the mining companies, whereas the government's focus should be on policy and actions that facilitate the sustainable running of mines, and that stimulate mineral exploration by qualified companies to define new reserves.

In Armenia, mineral resources and reserves are classified and reported in accordance with the Russian system, which in turn is based on the old Soviet system. Conversion between the Russian system and international systems such as JORC and NI34-101 is essentially a technicality and a system for alignment of the two has been developed together by Russian experts and Committee for Mineral Reserves International Reporting Standards (ref). Companies that calculate resources and reserves using international systems are required by the authorities to report these also according to the Russian model.

Summarising the above, apart from its work in policy development, it is clear that MENR devotes most of its resources to keeping track of mineral balances and assessing permit applications and inspecting companies to verify reserves and production rates, as well as to the administration of the mineral licensing process. In other countries, these functions are quite often performed by one institution, usually termed the mineral inspectorate. Overall, it is questionable how efficiently the strong focus

and significant human resources directed towards reserves verifications and approvals and inspections help to develop a sustainable mineral sector.

The Ministry of Nature Protection (MNP) is responsible for all aspects of policy development and implementation for environmental protection and rational use of natural resources in Armenia. With regards 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, and; regional environmental monitoring.

The Environmental Impact Expertise Centre (EIEC) performs the expert examination of EIA for exploration and mining projects, which is part of the permit application documents submitted to the MENR – MGA (the “one-window” or “one-stop-shop”). The EIEC perceives the “one-stop-shop” to hamper their work as much communication with the applicant must go through the MGA, the point of contact for the company. The EIEC also claim that collaboration with the MGA is not functioning well as disagreements are common with lengthy discussions as a result. EIEC’s decision on the EIA expert examination can, nevertheless, not be overruled by the MGA.

There is some 16 staff at the EIEC. While the new 2014 EIA Law requires social aspects to be included in the assessment, there is no staff holding social qualifications at the EIEC, and such expertise are invited from other institutions, and international organizations for expert advice.

The State Environmental Inspectorate is responsible for controlling the environmental performance of all industry in Armenia. Thus they inspect mining operations for environmental compliance.

The Environmental Impact Monitoring Centre regularly samples water, air and sediment across Armenia and analyse the samples in their own laboratories. The sampling site network include several locations that are strategically positioned for assessing impacts from mining activities on the natural environment. The laboratory houses modern equipment such as an ICP-MS quadrupole, and laboratory proficiency testing shows overall good precision of the analytical results. There are, nevertheless, room for much improvement as the premises are so run down that it is not possible to keep a stable and clean environment. Furthermore, work procedures are not in accordance with laboratory standards as, for example, there is little or no use of laboratory clothing, dust depressors, etc. to reduce the possibility for contamination. Finally, the data itself is not organized in a proper database where it can be retrieved easily and quickly. Thus, apart from the centre’s own yearly state of the environment reports, the data appears to be little used.

Overall, a key issue at the MNP seem to be a lack of human as well as technical capacity. Thus, the implementation of the new EIA Law is likely to be challenging.

The 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 (cf. Chapter 8). Despite good attempts within this project, it has not been possible to establish knowledge levels, responsibilities, and work procedures for the above within this project. From discussions with key informants it appears, however, as if the required knowledge level with regards to tailings dams construction and management do not exist among Armenian governmental institutions.

5.2. Mineral rights and EIA application process

With the RA Mining Code 2012, the process for the application for mineral rights was changed so that the Mining Granting Agency, as a separate division of the MENR, functions as what is common referred to as a “one-stop-shop” (Figure 5.1). Thus, as mentioned above, the MGA receives the applications, sends relevant parts to other authorities for expert examinations, reviews the result of these examina-

tions, and finally recommends the outcome to the Minister of Energy and Natural Resources.

Applications for mining rights are subject to two expert examinations (environmental and technical safety), while the expert examination for approval of established reserves for further extraction is performed during the last stage of the exploration phase (after the exploration has been completed). In the past, exploration applications were not subject to expert examinations, while the recent change in EIA Law (2014) incorporated the concept of "preliminary EIA" for geological exploration.

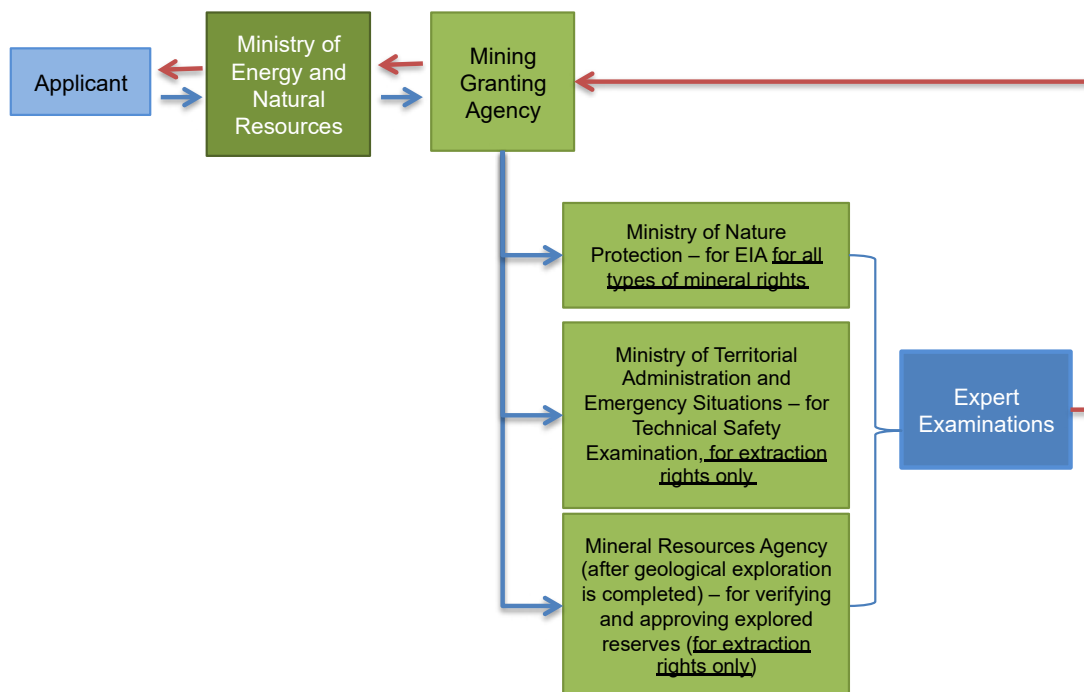


Figure 5.1. Mineral permit application process with MENR (essentially MGA) performing the function as the “one-stop-shop” and with expert examinations performed by three different offices (note: the MRA expert examination of reserves is not part of the mining permit application but is completed prior to that, at the end of geological exploration).

Applications for exploration permits are processed in the following stages:

- Within 10 days after registration of application, MENR delegates the MGA to review the geological exploration work plan and submit the application to the Ministry of Nature Protection (MNP) for reviewing of the preliminary EIA and environmental plan;
- Within 15 days after receiving the environmental plan, MNP shall provide their conclusion on the assessment to the MGA;
- Within up to 60 days after receiving a positive conclusion, the MGA prepares and submits package of relevant documents to MENR for the Minister’s approval.

For mining permit applications, the following steps apply:

- The Ministry delegates to the MGA to review the application for completeness. Within 10 days after the registration of application, the MGA delegates expert examinations to the relevant authorities (Figure 6.1), including:

- EIA expert examination (delegated to MNP). The EIA examination, subject to the EIA Law, is examination is conducted by the Environmental Impact Expertise Center,
- Technical safety expert examination, subject to the Law on State Regulation of Technical Safety, is conducted by the National Center for Technical Safety Expertise of the MES;
- Verification and approval of reserves estimations, by the Mineral Resources Agency. This is in reality done at the end (after 3 years) of a company's exploration permit, while the estimates are included in the mining permit application.
- The EIA examination must be concluded within 100 days, and the technical safety examination must be concluded within 60 days;
- In the case assessment results are not provided within those dates, conclusions are considered positive and the relevant expert examination institutions are held responsible according to law;
- Within up to 180 days after receiving a positive expert examination conclusion, the MGA reviews the conclusions and prepares and submits the package with relevant documents to the MENR for the Minister's approval.

According to the above timeline, the whole process of assessing a mining permit application can take up to 1 year. However, this appears not be too streamlined with some specific requirements of the EIA process. Based on interviews at the MNP, the following EIA process is envisaged:

- a. Public notice, and public hearing.
- b. Company prepares initial technical documentation,
- c. Stage 1 (initial) assessment; maximum 30 days during which the MNP prepares the Terms of Reference for the full EIA, including a list of stakeholders to be consulted. A second public hearing is held during Stage 1, organized by the MNP.
- d. The company prepares the full EIA. Looking at mining projects globally, this may take anything from 1 year and more. A third public hearing is held during the preparation of the EIA, organized by the proponent.
- e. Stage 2 (main) assessment; maximum 60 days during which the MNP examines the EIA and provides a conclusion. The main EIA is a complete assessment, including alternatives, justifications and cumulative considerations. A fourth public hearing is held during the Stage 2 assessment, organized by the MNP with participation of territorial administration bodies from target communities and the head of community.

While the effective time for the assessment of a mining permit application would be about 1 year, the whole process from the first public hearing to a final permit granting would be substantially longer. Our observation is that times for review and approval are normal by international comparison, or even short, faced with the complexities of relatively large metal mining project. Non-metal mining project applications, on the other hand, are not likely to require the same detail and time for examinations. Furthermore, to hold four public hearings is not unusual, and during the time a company prepares an EIA, even more public participation than a couple of public hearings should be expected (according to international best practise).

Interviewed officers at the MENR commonly perceive what they regard as a high number of public hearings as a problem, and that the EIA process is so time consuming that it negates the basic purpose of the "one-stop-shop", that is to facilitate quick application review and processing. As mentioned above, on the other hand, officers at the MNP perceives the "one-stop-shop" as a problem as it to some extent prevents the MNP to communicate directly with the applicants, and there are also commonly disagreements between MENR and MNP in the decision-making process.

5.3. Recommendations

It is proposed that the amalgamation of the MGA, MRA and the SMI into one institution is considered. While these institutions today are charged with different tasks, their functions overlap and could be better coordinated within one institution. For increased efficiency and transparency, it is furthermore recommended that a modern computerized mining cadastre system is established within such an institution, holding information on permits, production, compliance, etc. This would replace today's separate non-computerized systems and also mean that information does not need to be submitted to, and housed by RGF.

Within this new function, the abandoning of tight control of production rates and mineral reserves should also be considered to free resources for other purposes and functions.

Related to the recommendation under chapter 2 on the collection of geological data and information, the establishment of a geological survey function should be considered, which apart from collecting new data could make use of the abundance of old data and information. Such a function would be fundamental to promoting the opportunities for mineral exploration in Armenia.

The "one-stop-shop" concept has increased in popularity across the globe in the last 10 years. However, the effectiveness of the entire system depends on the performance of different offices involved. Mechanisms for better collaboration and increasing the understanding between MENR and MNP with regards to each other's importance and purpose of work need to be explored. This could for a start emerge through a common development of a mineral policy, as discussed in the preceding chapter.

Finally, capacity building is recommended, in particular for mining environmental and social management. This includes both technical and human capacity, and with regards to government at both the federal and marz levels.

6. Economic analysis

6.1. Introduction

Armenia was one of the first post-Soviet countries to achieve positive economic growth after having experienced severe economic problems during the early years after independence. In 1991, the GDP per capita was around USD600, whereas four years later it had decreased to USD500. After these difficult years followed a period of economic growth, which was accompanied by liberalization, as well as by substantial official development assistance.

The late 1990s saw major structural changes in the economy. Industry, which in 1990 accounted for 45% of GDP, constituted only 28% in 1995. Armenia lost much of its industrial capacity during this time, and the economy instead became more heavily based on agriculture and trade. These major changes caused corresponding shifts in employment, and also increased unemployment. In the late 1990s, most of the privatization efforts had been completed. At the turn of the millennium, the GDP per capita was USD621.

As a result of reforms and due to positive world economy dynamics, possibilities for accelerated economic growth emerged in the beginning of the 21st century. Thus, during 2001-2008 Armenia's real GDP grew by more than 11% annually, and the country was referred to as the "Caucasian Tiger". The main driving forces of the economy at this time was the construction sector, which in turn comprised government initiated infrastructural projects (involving Diaspora related funds), and private investments in real estate development, mainly in Yerevan. Remittances from Armenians working abroad were also important, and these comprised as much as 18% of total GDP in 2007, compared to just 4.5% in 2000. In spite of various structural problems, the standard of life improved considerably and in the beginning of the financial crises (2008) GDP per capita in Armenia reached its highest level at USD3,858.

The financial and economic crisis of 2008-2009 affected Armenia severely, and it was among the countries with highest GDP decline (14.2% in 2009). The major reason for the deep recession was an excessive reliance on construction sector. To overcome negative consequences of the crises, the Government of RA conducted expansionary fiscal policy in order to boost aggregate demand. As a result, the economy started its recovery in the years that followed but the implementation of such a policy came at a cost of substantial increase in external debt. A longer term result of the crises was a shift in the economy, where construction lost a large part of its input in GDP, where the economy became more diversified, and where industries input as well as input of other sectors in GDP started to increase.

6.2. The mineral sectors importance

The minerals sector is an important part of the Armenian economy. During the last 14 years, mining and quarrying sector has on average contributed 2.2% to overall GDP directly (Figure 6.1). In recent years, of the average annual real growth rate of 3.3% over 2013-2015, 0.4 percentage points (or about 12% of the growth rate) was attributable to the mining sector. Also in terms of productivity, the mining sector outperforms other industrial activities; according to 2010-2014 average indicators, the mining sector is responsible for 9.2% of the total industry employment, whereas it contributes to more than 16.7% of industrial output³. The sector has also been able to attract tangible foreign investment, most notably in the period 2004-2007 when Cronimet GmbH invested in the acquisition and modernisation

³ Source: Publication "Main Indicators of Industrial Organizations by Economic Activities (five-digit code), for January-December" (various years, (in Armenian) available at www.armstat.am and authors calculations

of ZCMC but also in 2012 when investments were made by Vallex to start the Teghut mine (Figure 6.2).

Mining and its downstream metal production is the main foreign currency earner for the Armenian economy. During 2006-2014, around one third of total merchandise export was attributable either to mining and downstream production activities. Annual USD inflows from exports have been in the region of USD 500 million during the past 5 years (Figure 6.3).

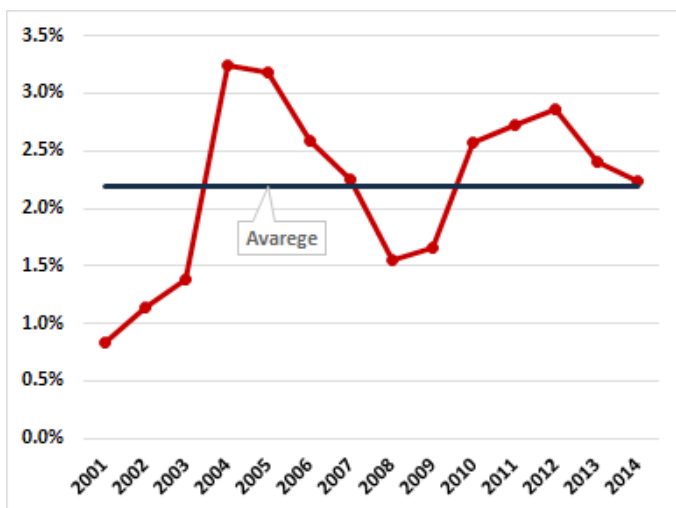
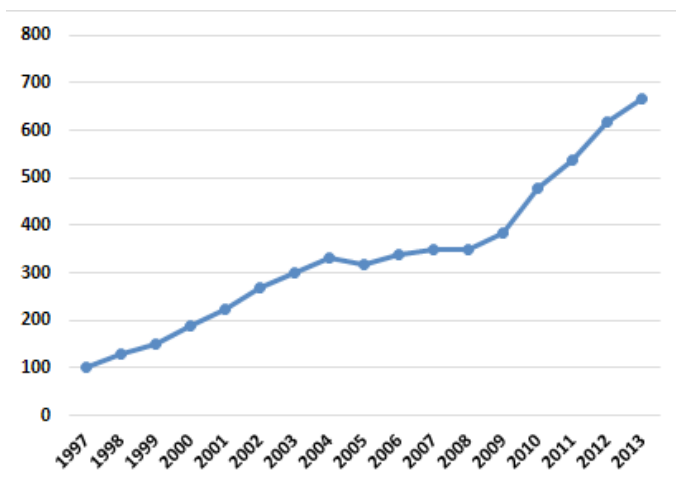


Figure 6.1. The mining sector's direct contribution, % of total GDP (upper panel) and mining sector output index since 1997 (lower panel; with the index for 1997 set at 100).

Source: www.armstat.am



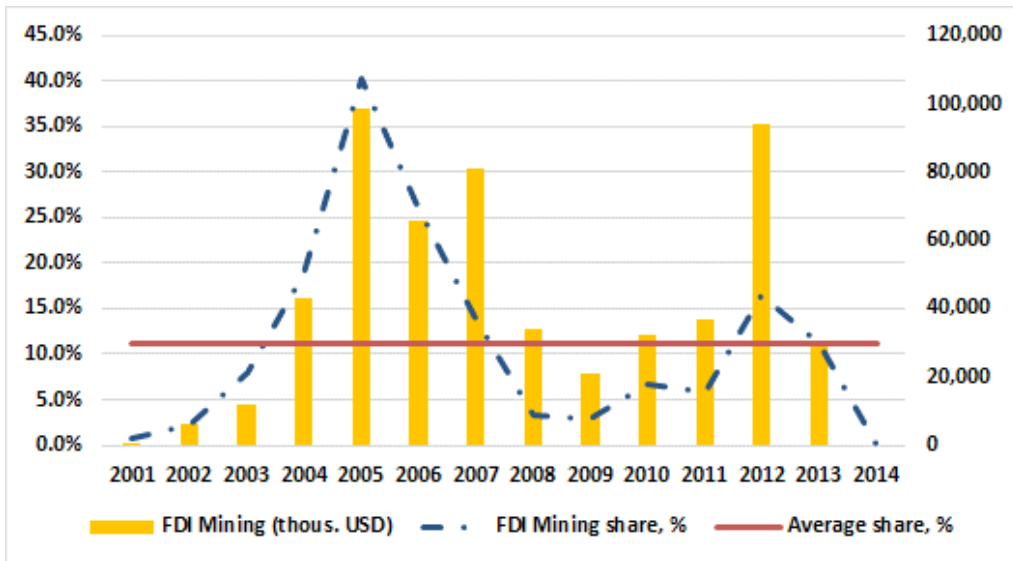


Figure 6.2. FDI in mining sector, thousand USD and share as of total FDI, 2001-2014. Source: Source: www.armstat.am



Figure 6.3. Mining ores and metal exports, USD million and % of total merchandize export, 2001-2014. Note: Metal exports include: product groups 7202 (Ferro alloys), 7404 (Copper waste), 7402 (Unrefined copper), 8102 (Molybdenum). Source: www.trademap.org.

Mining companies are also significant job providers, especially so as they can offer comparatively highly paid jobs outside of Yerevan. In 2014, 7,057 people were employed in the metallic mining sector, representing 90% of total employment in overall minerals sector, which in turn equalled around 10% of those employed in the industrial branch of the economy. Their average wage in 2014 is reported to have been AMD 328,000. On average during 2010-2014, the mean wage in the mining sector was about 67% higher than the mean wage in the private sector.

Non-metal mining companies, are less important for the economy. In this sub-sector the companies are smaller and, more numerous but also more widespread across the country. Average number of workers in metallic mining companies is 784 (9 companies are reported to have operated in 2014), whereas non-metallic mining had on average only 13 employees. The economic value of the total output of non-metallic mining is less than 5% of the sector's overall output (Figure 6.4).

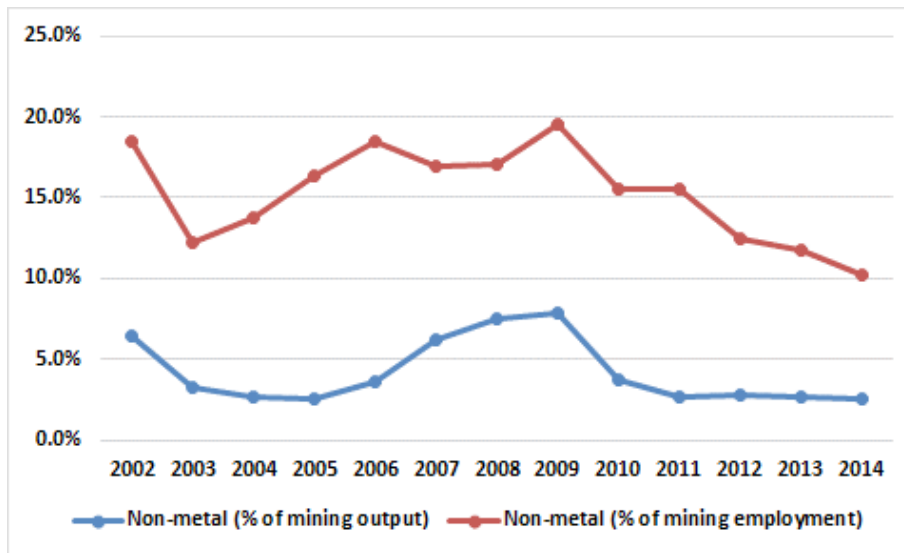


Figure 6.4. Share of non-metallic mining output and employment in overall output and employment of mining sector, 2002-2014. Source: www.armstat.am

6.3. Fiscal regime (taxes and royalties)

The two main types of direct taxes are Corporate Income Tax (Profit tax) and Personal Income Tax (Income tax). The former is levied at 20% on taxable profits, whereas Income tax is applied with progressive rates, with average rate around 25%⁴. Value added tax (VAT) is the main indirect tax with rate of 20%. Table 6.1 summarizes the structure of government tax revenues by types during 2010-2014, and there are a few tendencies worth highlighting. The share of indirect taxes has been decreasing, whereas among direct taxes, environmental fees (which include also royalties, see below) and personal income taxes are increasing. Finally, overall tax collection, as measured with tax to GDP ratio has been improving, which is thought to be due to higher tax compliance through improved tax administration.

Apart from a limited number of import duty exemptions related to machinery and equipment, the tax rules and regulations for mining companies are the same as applied to other industries. However, mining projects pay royalties on production. In Armenia, the royalty percentage has a floor of 4% and rises (with no upper ceiling) in relation to the profitability of the operation, according to the following formula:

$$R = 4 + (P / (S \times 8)) \times 100, \text{ where}$$

R – royalty percentage rate.

P – Earnings before interest and taxes (EBIT, if negative zero is applied), excluding losses carried forward from previous years.

S – revenue from the sale of products net of VAT.

⁴ Personal Income tax marginal rates are: 24.4% for income less than AMD 120,000 (as of December 2015 – around USD 250), 26% for income above AMD 120,000 and 36% for income above AMD 2,000,000.

Table 6.1. Structure of state budget revenues by tax types, 2010-2014.

	2010	2011	2012	2013	2014
Total tax revenues in state budget	100%	100%	100%	100%	100%
Indirect taxes	50.0%	47.3%	47.7%	45.4%	46.1%
VAT	43.1%	42.3%	42.1%	40.2%	41.4%
Excise	6.9%	5.1%	5.6%	5.2%	4.8%
Direct taxes	50.0%	52.7%	52.3%	54.6%	53.9%
CIT	11.1%	12.6%	13.5%	12.4%	9.7%
PIT + Social contributions	25.6%	26.3%	25.1%	27.4%	28.3%
Environmental fees	1.3%	1.6%	3.0%	3.5%	3.3%
Other direct taxes	11.9%	12.2%	10.7%	11.3%	12.5%
<i>Memorandum Item</i>					
Tax to GDP ratio	20.2%	20.6%	22.0%	23.4%	23.5%

Source: www.armstat.am

The royalty applied is an annual tax with quarterly prepayments based on previous year revenue/price pattern⁵. The base for calculating the fixed part of the royalty is the purchase agreement at the time the product is provided (price deductions for moisture or physical impurities are not taken into account, and final volumes can be no more than two percent less than initial reported volumes). Importantly, prices on which royalties are based may not differ by more than 10% from international prices based on LME data (Article 18, Law on Natural Resource Use and Environmental Protection Fees).

The system for calculating royalty is, comparing to many mining countries, somewhat complex as it includes a profitability component. For example, a simple royalty applied solely as a percentage to revenues is easier to administrate, whereas royalties with profit based variable component require closer scrutiny and can expose tax revenues to risks of profit under-reporting (using transfer pricing or any other tax avoidance technique). It is worth noting that a royalty that is at least partly based on value of sales (such as in Armenia) means that royalties are payable even when there is zero profits accruing to a company, or even when such a company is making a loss (see Figure 6.5).

⁵ In particular, if prices deviate by more than 20% prepayments should be scaled up or down by the same factor as the price deviation is.

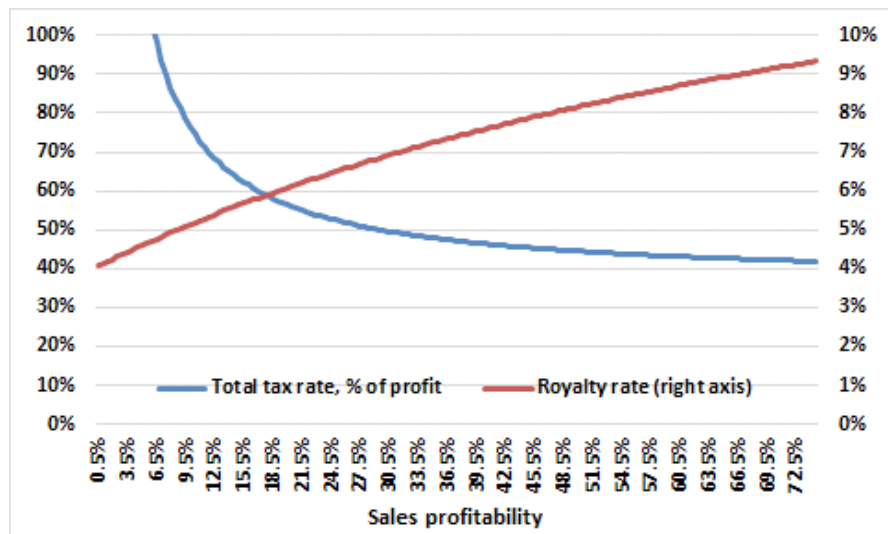


Figure 6.5. Taxes (royalty + CIT) to profit rate and Royalty rate as a function of sales profitability.

Mining sector and its downstream and supporting activities are important contributors to public revenues. Thus, Table 6.2 show how during 2012-2014, the mining sector provided on average 4.8% of overall taxes, and 8.2% of direct taxes collected by the government. When accounting for downstream and supporting activities these figures are even higher. Thus, for a country where mining sector's contribution to GDP is less than 3%, the tax contributions from the sector are comparatively high.

Table 6.2. Contribution of mining sector, downstream and supporting companies to direct and total taxes collected in Armenia, 2010-2014.

	2010	2011	2012	2013	2014
Contributions to overall taxes					
Mining	2.7%	5.0%	5.5%	5.6%	3.2%
Mining, downstream, supporting	3.3%	5.7%	6.3%	6.4%	4.1%
Contributions to direct taxes					
Mining	3.9%	8.1%	8.7%	10.3%	5.4%
Mining, downstream, supporting	5%	9%	9%	11%	6%
<i>Memorandum Items</i>					
Total taxes (state budget), mln. USD	1,871.9	2,087.0	2,203.8	2,391.7	2,467.2
Direct taxes (state budget), mln. USD	936.3	987.6	1,051.2	1,084.8	1,138.2

Source: www.armstat.am, www.taxservice.am.

A comparison with tax rates in with countries having similar mining sector structure shows that Armenia's is positioned at an average, medium level (Figure 6.6). This is a result of the fact that whereas the corporate profit tax rate in Armenia is comparatively low, this is offset by a higher royalty rate. In particular, the 4% fixed part of the royalty rate is higher than in many countries. For example, in South Africa where very similarly royalty rate mechanism is applied, fixed element of the royalty rate is 0.5% and there is also a ceiling on highest possible rate (5% of refined output and 7% for unrefined one). In

countries which use only a fixed element of the royalty, it varies from 3 to 6 percent (e.g. Kyrgyzstan, Kazakhstan, Ghana, Tanzania, Zambia). As Figure 6.5 demonstrates, even moderate profitability rates bring Armenian royalty rate to high levels⁶, and it demonstrates how the relative tax burden increases when the profitability drops (this reflects the fact that mining companies still have to pay royalties out of revenues even if the profitability of operations is low or even negative).

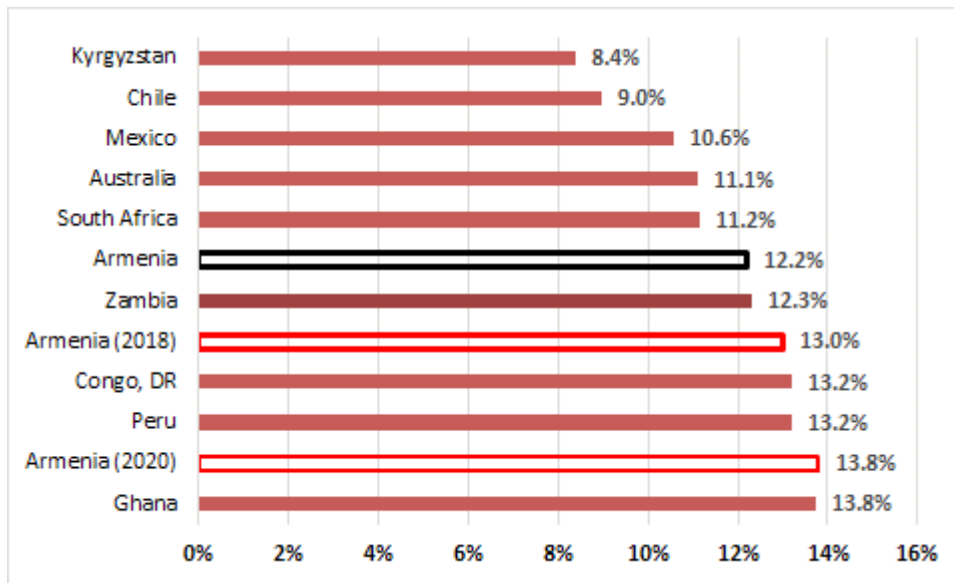


Figure 6.6. Tax (royalty + CIT) to turnover ratio for selected countries, estimation based on application of statutory tax rates; Armenia (2020) is based on a previous proposal for increased royalty rate, see text for further explanation). The calculations are made under some specific assumptions on profitability using the maximum tax rates for each tax type for the countries considered. The calculations are indicative and they ignore any kind of complications associated with adjustments to revenues and profits, which are usually required by law. According to these estimations Armenia's statutory tax burden is close to the mean of the countries considered (12.2% of sales/revenues). Assumptions: Profit to revenue ratio = 0.3. Maximum rates are applied for all countries apart from Peru, where mean of available rates on royalties is considered. Type of ore: copper. Source: PwC and Consultant's estimations.

It is also important to identify specific features of the taxation system that might create problems for the efficient application. Thus, one of the elements of the royalty tax system disputed by the mining companies is the rule of maximum 10% deviation of contract (invoice) prices from LME official quotations. A typical contract applied traditionally within the industry is based on LME price for the concentrate. At the same time, it envisages deductions to acknowledge that to obtain final product the buyer still has to incur certain expenditures. Major elements of these expenditures are Treatment charges and Refinery charges (TC/RC). Review of international practice suggests that TC/RC are negotiated annually between miners and smelters. There is very limited publicly available data on TC/RC relationship with metal prices. According to estimates of TC/RC share in copper price reported by "CRU Analysis", a mining sector consulting company, during 2004-2008 the indicator varied from 5 to 20%⁷. Data on typical TC/RC provided by an Armenian mining company suggest that TC/RC can be as high as 16% when prices for 24% copper concentrate are USD 5,000, and TC/RC drop to 11% when prices are as high as

⁶ Importantly, profitability used in Royalty rate formula is the rate before interest and taxes, so can be relatively high.

⁷ Information is available in a presentation developed by Boliden Commercial AB in 2008. Available at: http://investors.boliden.com/afw/files/press/boliden/Kokkola-2008-6_Smelters_Copper_US.pdf

USD 7,500. According to Armenian practice, TC/RC includes also transportation costs which double the rates presented in the previous sentence. While we do not find evidence in international experience on inclusion of transportation expenses in TC/RC, this issue requires additional scrutiny in Armenian legislation and regulatory practice. But even if transportation issue is ignored, it seems that 10% maximum deduction envisaged by the regulation puts the mining companies in difficult situation when prices are not very high. Moreover, the current regulations do not make it explicit that 10% deviation is meant for consideration of TC/RC in the contracts. There is a concern that mining companies interpret this regulation as an allowance threshold for such charges. To put it differently, the issue is not in the statutory formulation of the regulations, but in the perceived economic rationale behind such a clause.

Sometimes countries choose to apply ring-fencing of mining projects. Ring-fencing refers to application of tax rules on a license-by-license basis, such that the costs attributed to one mining project are not used to offset the profits from another, as would be allowable where taxes are calculated on a consolidated group basis. Ring-fencing prevents companies from reducing or deferring income taxes on a profitable mine by offsetting the profits of one mine with the costs of the other. While Armenian legislation does not seem to have ring-fencing requirements, a detailed analysis of ownership of gold and copper-molybdenum metal mines in Armenia reveals that each mine is operated as a separate legal entity even if it is a part of a larger group⁸. Thus, currently, the need for ring fencing is not an urgent issue, although the possibility of companies choosing to structure or restructure in such ways that it becomes a necessity should be anticipated and planned for.

Another issue that could potentially decrease tax payments from mining companies is the absence of transfer pricing rules. While this is a general issue for any sector, but is specifically important for resource extracting companies, which are more often supplying to their affiliates. The draft of the RA Tax Code includes a section on transfer pricing rules, which is meant to limit level of discretion available to the companies. According to preliminary statements, it will come into force in January 2018.

The initial draft RA Tax Code envisaged an increase in the fixed part of the royalty, from 4% to 5% in 2018, and to 6% in 2020. As figure 6.6 suggests, that would shift Armenia to the group of countries with highest tax rates. Such measures could cause significant problems for mining companies. It is important to recognize that large mining companies have a systematic role in the Armenian economy and financial problems in this sector may contaminate the banking sector, whereas possible laydown of employees will cause distress for the areas where the companies are operating. The most recent version of the draft RA Tax Code, however, does not suggest any changes to the royalty rate.

6.4. Assessment of revenues

The analysis of the mining sector is based on data on the main mining and downstream companies of Armenia (Table 6.4). These companies are all among the 1000 major taxpayers, and data are therefore available in the reports published by the Tax Service of the Ministry of Finance.

On average during 2010-2014, these companies have paid annually USD115 million or 5.2% of total tax revenues of the country. Figure 6.7 present the structures of taxes by industry profiles and by type of taxes. Thus, it shown that royalty payments have increased since 2012. Further, in spite of negative price dynamics in 2013 they continue to increase. Whereas commodity prices in 2014 are roughly at the same level as they were in 2010, but both royalties and direct taxes paid are considerably higher in 2014. This demonstrates how the change in the tax regime of 2012 has increased public revenues from the sector.

⁸ Such an inventory of mines by legal status is available at: <http://transparency.am/en/assets/mines>

Table 6.4. List of companies for which tax payments are taken into consideration when calculating tax contributions from the mining and downstream sectors.

Mining of metallic ores
Zangezur Copper Molybdenum Combine Closed Joint Stock Company
Dundee Precious Metals Kapan Closed Joint Stock Company
GeoProMining Gold Limited Liability Company
Agarak Copper-Molybdenum Mine Complex
Akhtala mining and processing enterprise Closed Joint Stock Company
Sagamar Closed Joint Stock Company
Meghradzor Gold Limited Liability Company
Geoteam Closed Joint Stock Company
Downstream metal production
Armenian Copper Program Closed Joint Stock Company
Makur erkat gorcaran Open Joint Stock company (Pure Iron Plant OJSC)
Dzulakentron Open Joint Stock Company
Professional direct services to mining industry
Armenian Titanium Production Limited Liability Company
Aparaj Mining Limited Liability Company
Lermetin
Zangezur Mining Limited Liability Company

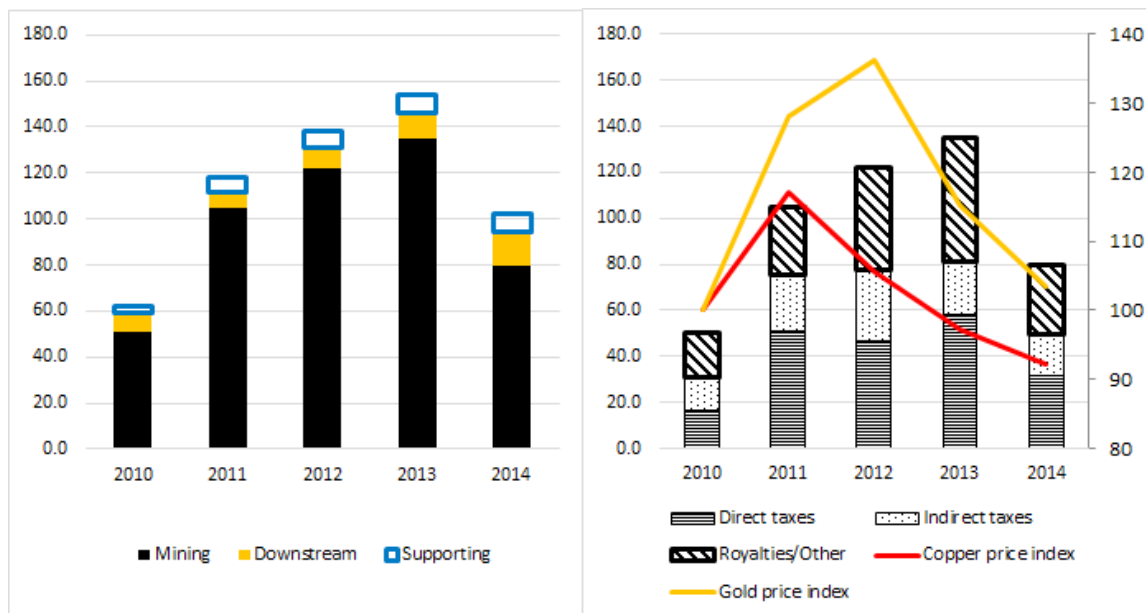


Figure 6.7. Taxes paid by mining and adjacent sectors' companies in (left panel) and type of taxes paid by mining companies (right panel) in 2010-2014. Source: 1,000 largest taxpayers in Armenia, data published by Tax Service of Ministry of Finance of RA, www.taxservice.am.

It is noteworthy that Armenia's mining sector is not just characterized by relatively high taxation rate, but the actual tax contributions to the economy are also quite high compared with other countries (see Figure 6.8, with data from 2013).

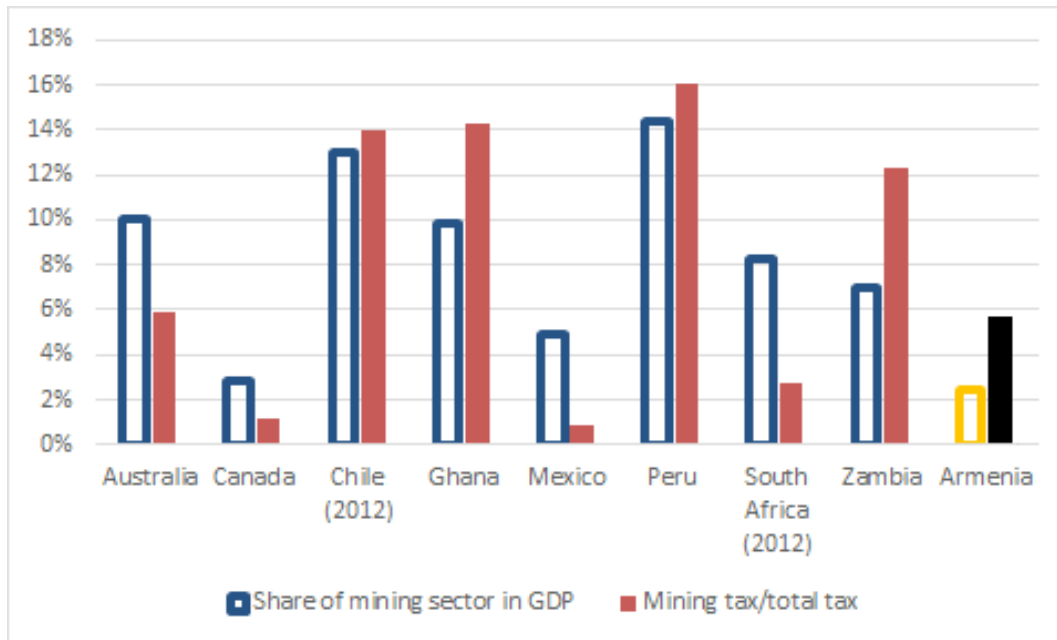


Figure 6.8. Actual tax contributions and contributions to GDP for selected countries in 2013 (if not indicated otherwise). Although focusing just on one year is somewhat problematic, data constraints prohibits a more comprehensive cross-country comparison. When solid fill bar (tax contribution of mining sector to overall taxes collected) is higher than the no fill bar (share of mining sector in GDP) it indicates that tax collected from mining sector are relatively higher than taxes collected from the overall economy average.

One major concern regarding the contributions from the mining sector is the great reliance on ZCMC. Thus, ZCMC was profitable during this period, and it accounted for about 60% of turnover of all active mining companies during 2010-2014. As for total taxes paid by mining companies, ZCMC's share during the same period was even higher (66%). Generally, company concentration of tax contributions depends on two things – size effect and profitability effect. While it is clear that major portion of this high tax share stems from the size effect, it is also important to understand whether profit making pattern of ZCMC also differs from other companies. This is of particular importance, because current royalty rate directly incorporates profitability into its formula.

A profitability analysis (profit calculated for taxation purposes to revenue ratio) conducted on data provided by Ministry of Finance reveals that in fact loss making is a common pattern for the metal mining companies. Thus, of the total 14 operational mines, 8 have been running at an amalgamated loss over the period 2010-2014, and most of these have been making a loss each individual year. These types of mines, in particular after consecutive years of making a loss, need cash in-pur to be kept in operation. Part of the explanation for this pattern may be that the owners seek to promote the project for selling or for investment into further work on extending reserves.

Some mining companies have voiced concern over the effects of the present royalty regime, claiming that it is excessively onerous. We have used available data to assess the effect of the changes made

(Figure 6.9). Volatility in profits and the short time period that has passed since the new mining code was enacted in 2012, makes it somewhat difficult to make empirical analysis of what the change in royalty burden after 2012 has meant. However, Figure 6.9 demonstrates that the effective royalty rate (for profitable companies, including ZCMC) was higher in 2013-2014 compared with 2010-2011. And this is in spite of decreasing copper and gold prices.

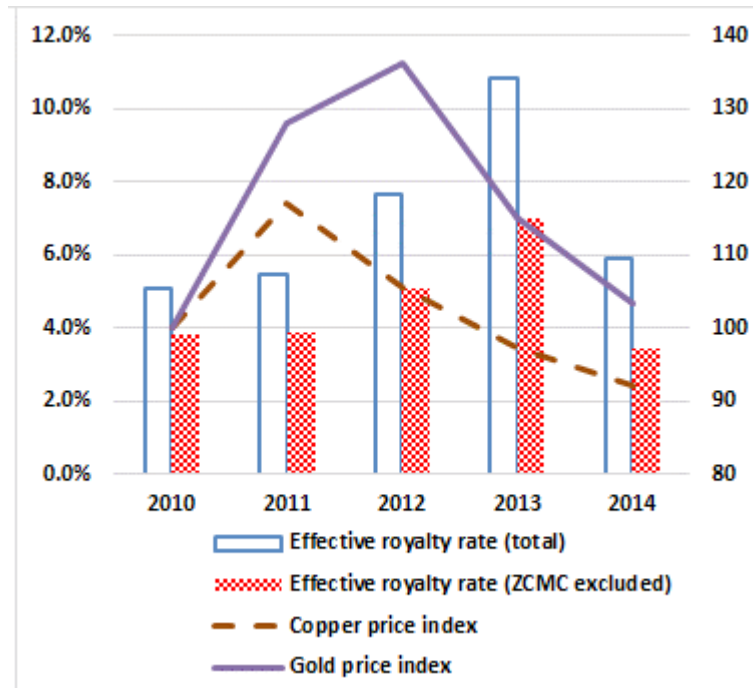


Figure 6.9. Effective royalty rates (right panel) in 2010-2014. Source: Ministry of Finance and Consultant’s estimations.

In order to overcome data inconsistency problem in analysing the royalty burden change in 2012, we have applied 2013 production data (actually produced metal structure and actual prices) to different profitability rates. Thus, in Figure 6.10 it is shown that largest difference between the two royalty regimes is observed at 25% profitability. In Figure 6.9, it is shown that the effective royalty rate for the mining sector excluding ZCMC was about 7%, which corresponds roughly to 24% of profitability rate. Note that under the old regime royalty rate would be just 3.64% (Figure 6.10). In terms of 2013 actual data, under the new regime USD28 million would be collected, about double the USD14 million which would have been collected under the previous royalty regime.

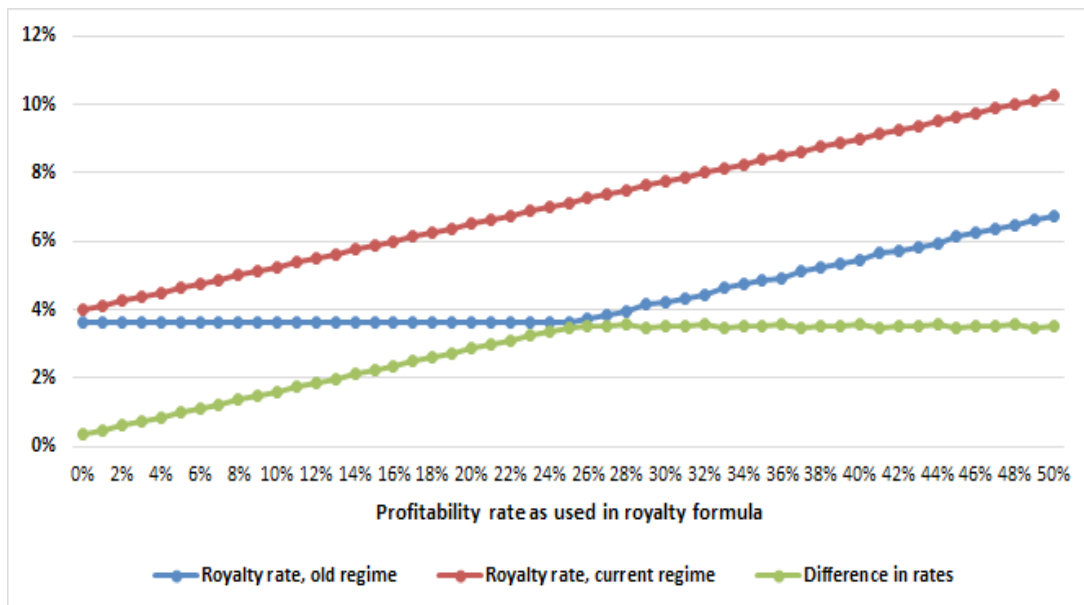


Figure 6.10. Estimation of royalty rates under current and previous royalty regimes for various levels of profitability.

6.5. Assessment of revenue and job creation potential of new projects

Predictions of medium-term future developments depend on the successful implementation of Teghut mine project (which started in 2015) and the Amulsar Gold mine project. Due to operationalization of Teghut mine around 1,400 jobs were created in 2015. According to existing plans, Amulsar mine will offer 770 additional jobs.

These two projects will also generate considerable tax revenues for the government. The Amulsar Gold Project is projected to be among the top 5 corporate taxpayers in Armenia, generating annually on average approximately USD50 million in taxes. As for Teghut mine, based on profitability assumptions presented in the technical documentation for the project after first years of operations and closer to full capacity the project will be paying around USD13.4 million profit tax, personal income tax and royalties. Though Teghut mine pays annually less taxes, its estimated life of the mine is more than 20 years, whereas for Amulsar project it is around 10 years. Figure 8.11 summarizes the expected additional effect of these projects on current tax contributions and employment level of the metallic mining. It is important to emphasize here that these are just direct revenue and employment medium-term effects of the planned mining projects, but the overall benefits are going to be considerably more significant due to indirect and induced effects of the operations. Extent of these effects are further discussed in the next section of the report.

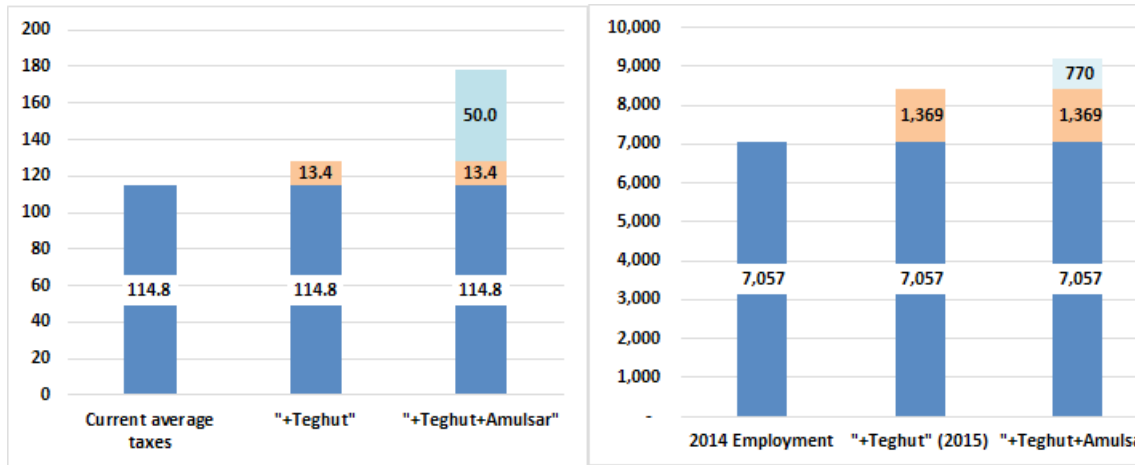


Figure 6.11. Expected additional direct effects of Teghut and Amulsar mining projects on tax revenues and employment. Source: 1,000 largest taxpayers in Armenia, data published by Tax Service of Ministry of Finance of RA, www.taxservice.am, www.vallexgroup.am, www.lydianinternational.co.uk

6.6. Potential for economic linkages

The contribution of the mining sector to the economy goes beyond direct or nominal impacts discussed in preceding sections. Its impact on the economy is larger through the multiplier effects. Appendix 1 presents some details of the methodology applied to derive indirect effects of the mining on the GDP, employment and other important macroeconomic variables. But the basic idea behind indirect effects is the attempt to account for the following main aspects: first, to produce its output, mining sector acquires products and services from other sectors of the economy and this creates additional demand for those sectors; second, income accruing to employees and in some cases to shareholders of the mines is spend on local products and services again creating additional demand for the remaining sectors of the economy; and third and finally, income earned by other sectors as a result of providing inputs to mining sector is also spent creating additional demand.

Thus, using an Input-Output model (developed by AVAG Solutions) output, gross value added and employment multipliers in other sectors due to increase of output in the mining sector re estimated. For the mining sector of Armenia, GDP multiplier is estimated at level of 1.8 and employment multiplier is 5.3. Though it is important to underline here that the employment multiplier is based only on indirect effects and not the induced effects. In other words, it takes into account additional employment due to purchases of the mining sector, but not the ones generated by spending of the additional income generated in the economy. This imperfection is due to level of details that the social accounting matrix of Armenia provides. Note that the mining sector GDP multiplier estimated for Armenia is comparable to what is observed in other countries (e.g. in Tanzania it is estimated to be between 1 and 2, in South Africa it is 2.7, whereas in Australia it is equal to 1.6). By using these multipliers, the overall economic contribution of the mining sector to Armenian economy can be evaluated. Results of such estimates for 2013 are summarized in Figure 6.12 below. Overall contribution of mining sector to the GDP was above 4% and employment generated by the mining sector together with its indirect impact was above 42,000. As it can be inferred from the figure, structure of indirect contribution for GDP and employment have similar pattern – with industry and construction sectors bearing the largest share of indirect positive externalities from the mining sector.

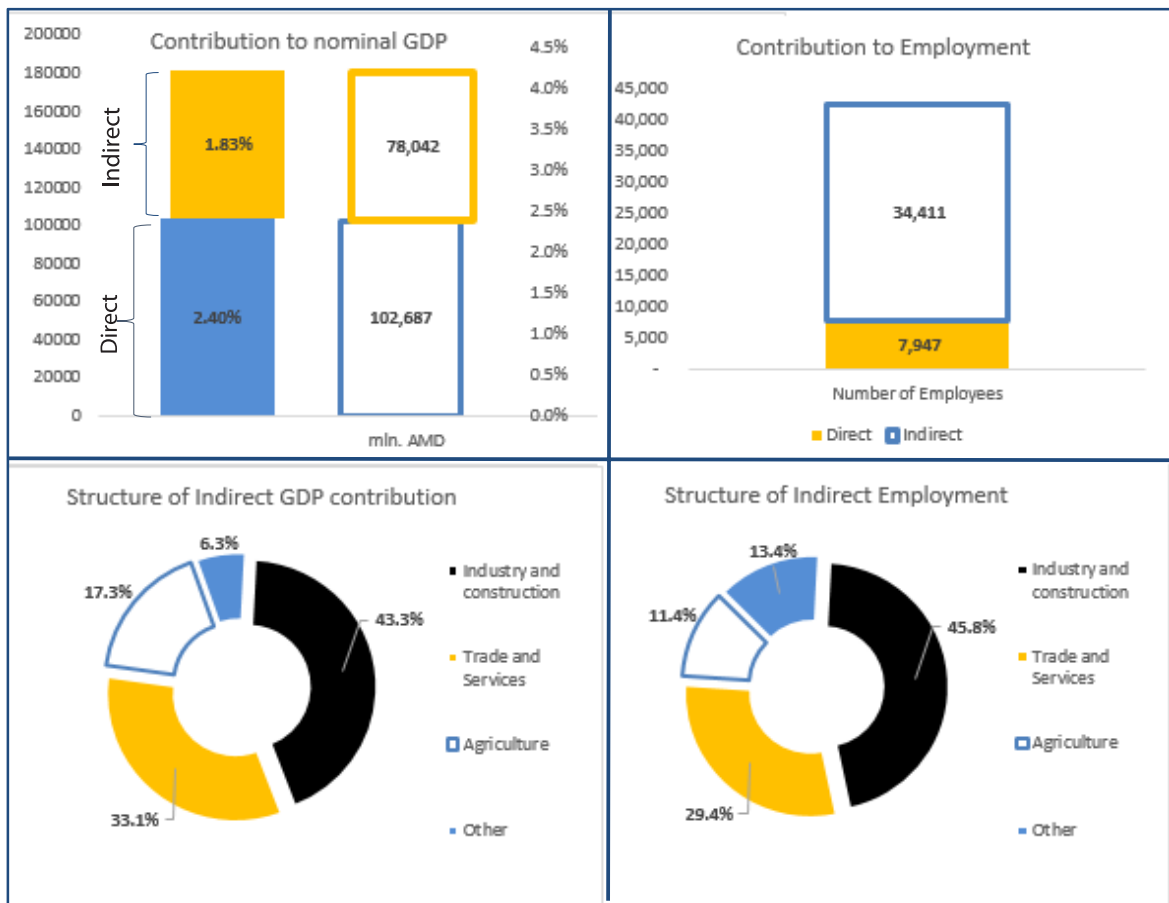


Figure 6.12. Direct and indirect contributions of mining sector to GDP and Employment in 2013 in Armenia. Source: Input-output Model developed by AVAG Solutions. Notes: Agriculture's employment is over-estimated due to problems associated with statistics of employment in that sector. In particular, according to current methodology used by National Statistical Service number of people employed in agriculture is considerably overestimated, which translates into the Social Accounting matrix used by the Input-Output model.

The discussion above represents overall linkages and effects within the economy. A number of issues requires additional consideration.

Armenia has educated workforce which calls for comparatively limited involvement of expatriate employees and usually at the mine construction and mining inception stages. Thus, for the Amulsar Gold mining project, only 5% of workforce are planned to be expatriates and this number is planned to decrease considerably after the first years of operations. Large involvement of local workforce creates favourable economic environment for the communities as spending occurs within the same area or at least within the same country.

The overwhelming part of business and financial services, as well as services associated with mine operations are acquired by mining companies locally. The natural limitation is associated with impossibility to buy locally produced machinery and equipment for the mines. There doesn't seem to be a room for any production of supplies even in the long-term perspective due to small size of the Armenian mining sector compared with world metallic mining output.

Possibilities of downstream production development are also limited. Current tendency is that large smelters are being used. Thus in China, 62% of copper smelters have capacity of 200 thousand tonnes per annum and larger and this is around 3 times bigger than Armenia’s annual copper production⁹. Further, poor connectivity makes Armenia an implausible destination for the smelting of ores from other countries.

By paying relatively high wages, mining creates favourable environment for local SMEs operating in trade and services sectors. Recent mining projects (like Teghut and Amulsar) are being implemented with considerable liaisons with local community representatives and real input by the companies in developing infrastructure in those communities (healthcare, education, more advanced agricultural technologies). This creates spill-overs that boost local SMEs.

Indirect contribution to GDP by the mining sector generates also additional tax revenues. In practice this means to take account of taxes collected from additional GDP generated due to activities of mining sector. We have applied tax to GDP ratio to indirect GDP increase obtained from input-output model to obtain an estimate of taxes generated from indirect economic effects of mining sector. On average during 2010-2014 tax revenues flowing from these indirect economic effects of mining are estimated to be more than USD40 million annually or almost 2% of total taxes collected (Figure 6.13). Note that taxes collected indirectly presented in the figure include contributions by downstream and supporting industries.

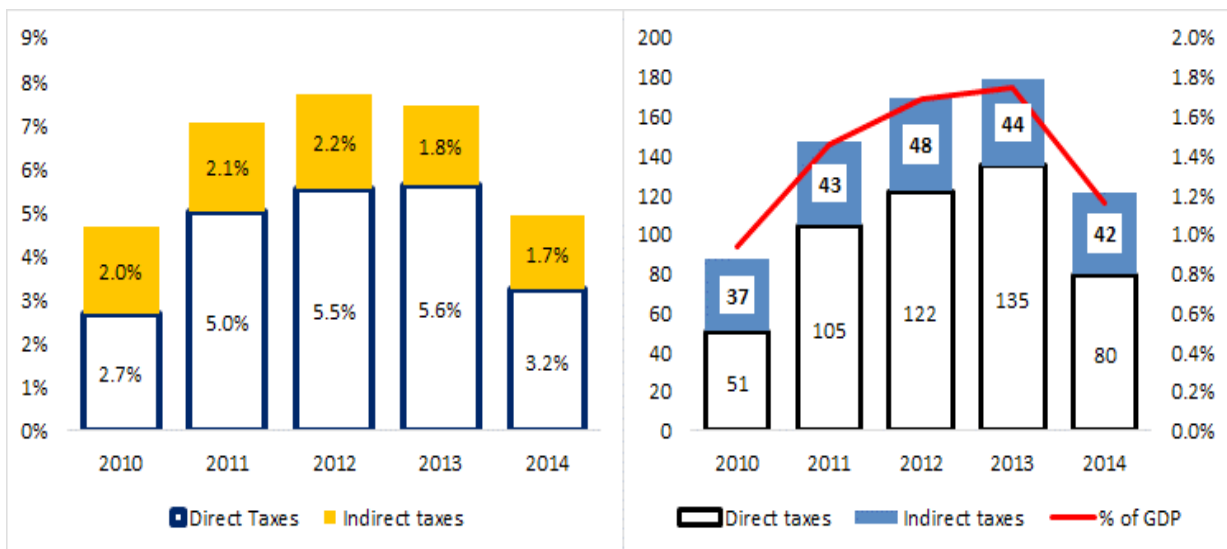


Figure 6.13. Direct and indirect (from indirect GDP generated due to mining) taxes as % of total taxes (left panel) and million USD (right panel) 2010-2014. Source: 1,000 largest taxpayers (various years; www.taxservice.am), consultant’s estimations.

6.7. Financial data and transparency concerns

In this assignment, we have had the benefit of being able to use data obtained from the Ministry of Finance. Comparisons of this data with other data that is available provide examples for the difficulties that exist in interpreting financial data related to mining activities. With regards to data profitability,

⁹ www.copperworldwide.com – Copper worldwide vol. 4, No.2,

taxes and royalties paid, we may compare Ministry data with data drawn from mining companies financial reporting. In Armenia, this is essentially only possible to do for Dundee Precious Metals, as this is a publically listed company, which required to supply rather extensive information on their operations. In this, they are at the moment in a unique position in Armenia, where it is much more difficult to obtain information about other mining companies operating.

Table 6.5 demonstrates how different can be the information supplied in company reports and official data. These difference may arise both due to methodological and definitional differences, that need to be understood. In this specific example the difference in 2014 royalties and turnover data reported can arise due to different treatment of taxable revenue by the company and by the government. For example, according to Armenian regulations the contract price for mining output sold cannot deviate from London metal exchange prices by more than 10%, whereas in international practice deductible charges can be more than 10%. With profit data it is even more complicated, as profit for tax purposes and profit reported in financial statements may differ to the extent of allowable deductions and expenses. The application of a transparency framework (e.g. EITI) could indirectly lead to convergence of various approaches to financial reporting used by both government and companies.

Table 6.5. Comparisons of selected financial data drawn from the Financial and Sustainability reports of Dundee Precious Ltd, with data derived from the Armenian Ministry of Finance

		2013	2014
1. Royalty, thous. USD			
Per Dundee sustainability report		3,017	2,397
Per MoF data		3,058	1,623
2. Turnover data, thous. USD			
Per Dundee financial report		44,131	38,810
Per MoF data		49,038	46,032
3. Profit data, thous. USD			
Per Dundee financial report			
Adjusted earnings (loss) before income taxes		-4,295	-6,587
Adjusted earnings (loss) before interest, taxes, depreciation and amortization		2,609	1,614
Per MoF data		3,311	2,684

6.8. Recommendations

The mining sector along with its downstream production and supporting services is an important contributor to public revenues. It is important to maintain enabling business environment and ensure stability of the sector under volatile commodity prices. In this regard, fiscal regime of the mining sector should be aimed at striking a balance between adequate taxation level of the sector and maintaining favourable business environment for current and prospective investment projects. At the same time taxation should take into account social costs of mining. Tax provisions should be approached with some degree of flexibility in order to account for unfavourable long-term developments in commodity markets.

The mining sector is characterised by a high concentration rate, with only major players having steady profitability rates. The development of regulations and tax policies for the sector must be based on an awareness of this fact. Tax policy could be calibrated with special consideration for some smaller and

medium sized companies (SMEs) bearing in mind, however, that actual metal mining and processing is usually not a sector suitable for SME involvement due to the requirement for longer term management and stewardship, and access to considerable resources and funds (c.f. Section 9.5).

Further increase in the royalty rate as previously planned by the initial draft RA Tax Code could considerably decrease returns on investment in the mining sector. Such changes would shift Armenia to the countries with highest tax rates, at the same time it needs to be acknowledged that Armenia is not a country with low production costs. In accordance with the most recent version of the draft RA Tax Code, it is recommended that the royalty rate remains unchanged.

Current regulation of treatment charges and refinement charges (TC/RC) is not clear. In particular, final contract (invoice) prices can deviate from LME prices at most by 10%, but the analysis of international practice suggest that these charges can vary from 5% to 20% of LME price, with higher share in times of low commodity prices. Some limited evidence communicated by Armenian mining companies confirms this observation. At the same time, it seems that Armenian companies include transportation costs in TC/RC, which is not internationally accepted practice. These issues require additional investigation.

According to Armenia's development strategy, the mining sector is expected to increase its contribution to the GDP. This is going to increase public revenues directly and indirectly – through horizontal and vertical linkages and through multiplier effects of spending by mine sector employees. Ensuring adequate local business environment is important so that benefits may also reach local communities in a fair and equitable manner.

Further steps should be undertaken to increase transparency and responsibility of the mining companies. Negative impressions within the society creates additional impediments for successful promotion of mining projects. Armenia's joining to Extractive industries transparency initiative (EITI) is an important step in the direction of more responsible mining.

7. Environmental and socioeconomic management

7.1. Human and physical geography

Armenia is a small, land locked, medium income country with a population of about 3 million. It is an ethnically and religiously homogenous country with Armenians making up 98% of the population (small minorities comprises primarily Yazidis, as well as Kurdish, Russians, Assyrians, Greeks and others). The vast majority of Armenians are Christian, belonging to the Armenian Apostolic Church. The country also has a large diaspora population. The table below summarises some further key facts about Armenia.

Most of the population live in the western and north-western parts of the country and sixty-four per cent live in urban areas – Yerevan and a few much smaller cities. The remaining thirty-six percent of the population live in villages and in the countryside.

Armenia's infrastructure (e.g. road- and railways, energy and power, water supply, telecommunications) are fairly well developed, although the needs for repair and renovation are substantial.

Armenia is mountainous, with the lesser Caucasus mountain range stretching from the northernmost parts (Virahayots Mountains) and to the far south (Zangezur Mountains). The continuation of these mountains also stretch into the territories of Azerbaijan and Iran. The Armenian Volcanic Plateau is situated in the south-western part of the lesser Caucasus mountain range, and thus cover the west and central parts of Armenia. Overall, the country is characterized by high altitudes, and large topographic variations; about half of Armenia has an elevation of at least 2,000 meters, and only three percent of the country lies below 650 meters. The lowest points are in the valleys of the Araks River (Meghri Gorge) and the Debed River (with elevations of 380 and 430 meters, respectively). The highest mountain is Mount Aragats (4,430 meters high), which raises above the Armenian plains in the central part of the country. All of Armenia is within an area that is seismically active.

Armenia has one major lake, Lake Sevan, which is also the largest lake in the southern Caucasus region. The lake is situated at an altitude of about out 2,000 meters above sea level.

The rivers of Armenia belong to the Kur and Araks rivers basins. The Pambak Mountains and the Sevan Mountains of Areguni form the divide between the two river systems. Thus, in western and southern Armenia rivers flow west- or southwards, and drain into the Araks river system, which stretches into Iran and Turkey. In the north and northeast, the Debed river and the Aghstev river systems drain northwards, into the Kura river system in Georgia and Azerbaijan.

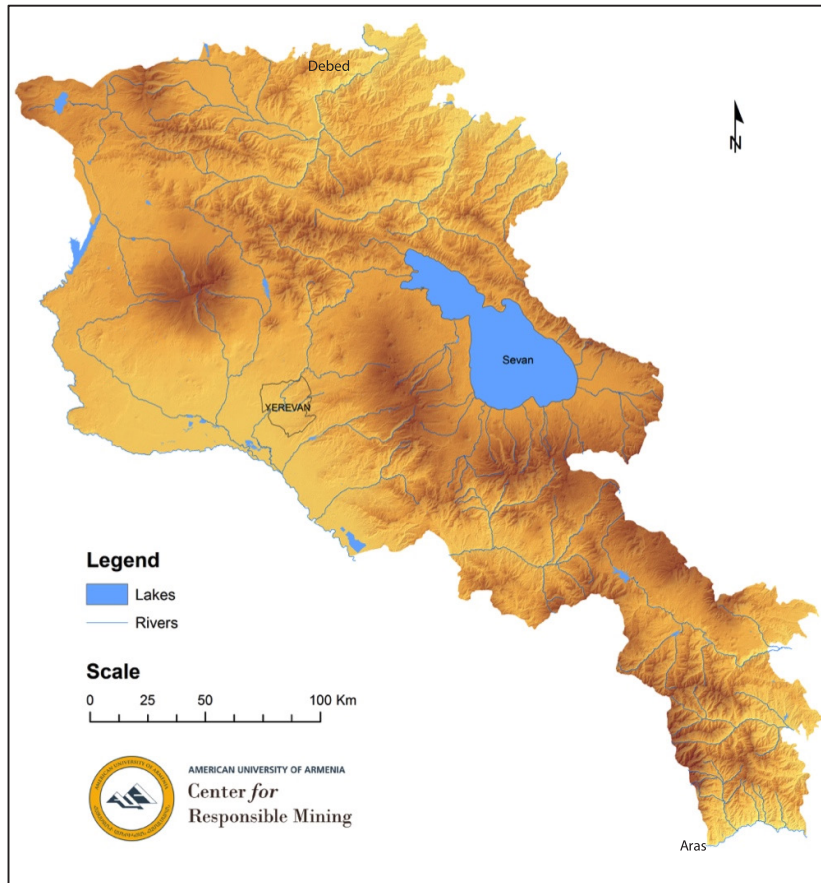


Figure 7.1. Map of Armenia, showing the main river systems.

The climate is continental with hot summers and cold winters. From variations in topography also follows considerable weather variations. Average precipitation ranges from 250 millimetres per year in the lower Araks River valley in the south, to 800 millimetres at the highest altitudes. On the Armenian Plateau, the mean midwinter temperature is 0° C, and the mean midsummer temperature exceeds 25° C.

The topographic and associated climatic variations result in highly diverse ecosystems, flora and fauna. The Caucasus has been defined by the WWF as one of the “ecoregions with globally outstanding biodiversity”. The forest cover is less than 8% of the country’s area. At present, the deforestation is largely due to illegal logging of forests for obtaining construction and fuel wood, although mining operations have also contributed significantly to the felling of forests in some areas.

7.2. Potential impacts from ongoing mining

Mining activities may be associated with negative environmental and social impacts. Internationally, such issues are being taken more and more seriously, and it is generally felt that the longer term viability of the whole mining sector rests in reaching a situation where mining is performed in an environmentally and socially responsible manner. This requires a sound understanding of the present and future impacts of mining development on the environment and society (Table 7.1).

Table 7.1. Potential negative environmental and social impacts related to 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 land form Land use in competition with other utilisation Destruction of natural habitat Land subsidence Land/soil erosion; changes in river regime due to siltation and flow modification Abandoned equipment, plants, buildings, excavations	Excavation of open pit mines Establishment of industrial areas for ore dressing Design of tailings dams and waste rock dumps Underground mining Haulage road construction Rehabilitation after closure
3. Water use and/or pollution	
Overexploitation of groundwater sources Changes in groundwater table Withdrawal of water in competition with other utilisation 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 of detrimental to humans and nature (PM10 and PM2.5) 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 Release of methane from coal mines
5. Soil pollution	
The 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. run-off 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 microfauna	The combined effect of contaminations radiating from mining operations Deforestation related to operations or the activity of intruding settlers

7. Noise and vibration	
Effects on human health Damage to buildings	Mine blasting Operation of vehicles and other heavy equipment
8. Radioactivity and uranium	
Gamma radiation Uranium as a toxic element	Radiation from natural sources Uranium in ores being exploited
9. Environmental emergencies	
Catastrophic failures of tailings dams Collapse of underground workings and their consequences at the surface 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
10. General issues in industrial establishments	
Oil and fuel spillages PCB CFC Spread of scrap Uncontrolled spread of sewage	Vehicle servicing Leaking transformers Leakages from refrigeration plants and air-conditioning Deficient materials handling
11. 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)	Start-up of large-scale projects in remote areas of little previous contact with major industrial operations Closure and loss of job opportunities
12. Occupation health and safety	
Intoxication by inhalation (cyanide, mercury, other toxic material) Intoxication by polluted water Silicosis Gamma radiation and radon Exposure to heat, noise, vibration Physical injuries due to accidents	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

In addition to the challenges that commonly are met with regards to mining environmental management, the natural environment in Armenia entails peculiarities that makes it a particularly challenging place to open and operate mines:

- a. The geography and climatic conditions are very varied, and related to this there is rich biodiversity. Furthermore, the country is tectonically active, and earthquakes and landslides are common.
- b. Being a small, land locked country this means that nearly all prospective areas in terms of mineral potential are situated in river catchments that cross national borders.
- c. Armenia's climate, and directly associated with this, economy is regarded as being sensitive to the effects of climate change SEI/UNDP (2009).

Further, many of the mineralization comprise sulphide minerals. Thus, these may have the potential to generate Acid Rock Drainage (ARD; see box), can cause extensive environmental damage, and proper management of ARD at mining operations is therefore imperative.

Box: Acid Rock Drainage

Acid Rock Drainage (ARD) or acid mine drainage refers to the acidic water that is created when sulphide minerals are exposed to air and water and, through a natural chemical reaction, produce sulphuric acid. ARD has the potential to introduce acidity and dissolved metals into water, which can be harmful to fish and aquatic life. The dissolved metals associated with ARD are often more toxic to fish and aquatic organisms than is the acidity. Preventing and controlling ARD is a concern at operating mine sites and after mine closure.

Source: miningfacts.org

7.3. Key environmental considerations

Whilst exploration licenses may cover extensive areas, mining itself is hardly ever a large user of land. Exploration activities are commonly allowed in certain types of nature protection areas while most valuable areas, such as national parks, are normally closed for both exploration and mining.

In Armenia, exploration licenses cover about 5% of the land (Figure 7.2), whereas mining licenses cover areas that are a few orders of magnitude less than that, corresponding to a fraction of a percent of the total land area. The main concerns in terms of land used for mining are therefore not foremost that they are particularly large but rather if such licenses are situated in sensitive areas, and whether the mine sites are being well managed so that the land can, after mining has ceased, be used for some other purpose. Furthermore, the sites themselves may become a source for contamination and pollution that may affect significant areas outside the mine area itself (see below).

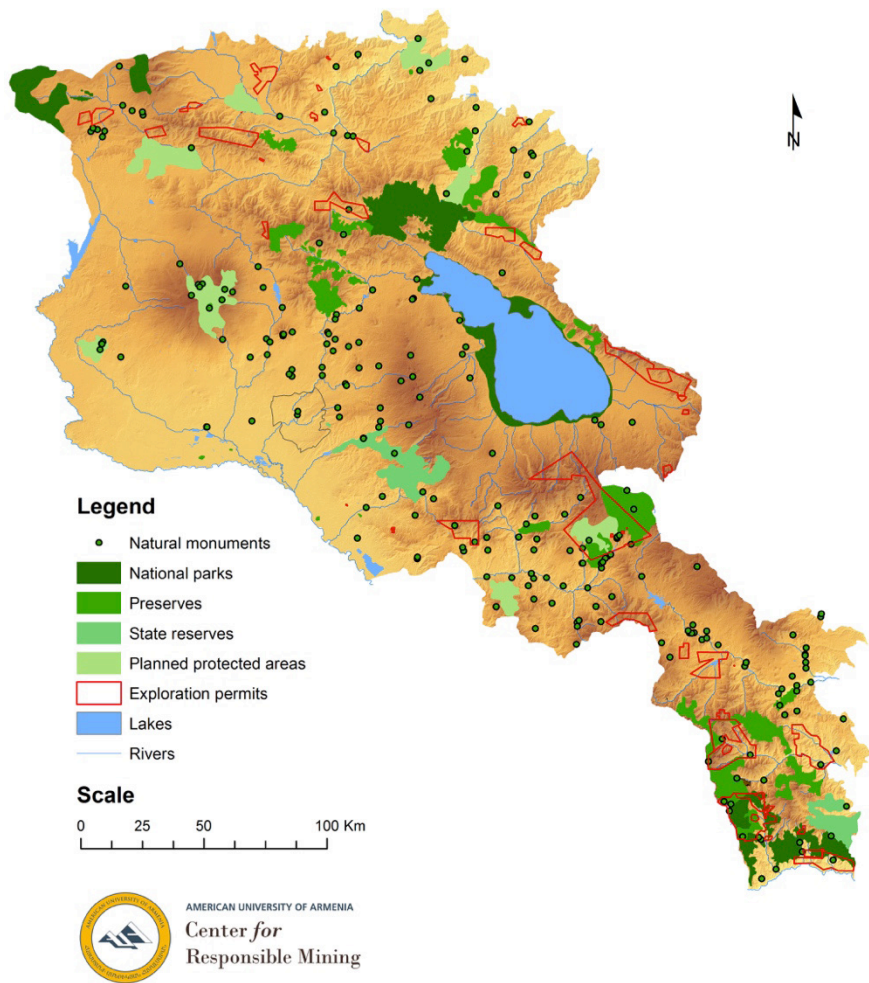


Figure 7.2. Map showing protected areas of Armenia in relation to active exploration permits as per December 2015.

The Armenian metal mines are mainly gold and base metal mines. These types of mines produce large amounts of waste rock and tailings material, and the ores are often associated with metals or metalloids that may be toxic to humans and nature. Spillages and/or leakages from waste and processes may lead to contamination of downstream waterways. Furthermore, the Alaverdi smelter has been a significant source of local and regional air pollution for a long time, and the spreading of contaminants through the air commonly also leads to local and regional soil pollution.

The larger mining companies (Dundee Precious Metals, ZCMC and Vallex Group) conduct voluntary self-monitoring but the data are not publically available. The Environmental Impact Monitoring Centre does conduct regular regional monitoring of water and air quality and summaries of results are provided to the public in their yearly “state of the environment” reporting. The Center does not conduct soil monitoring, mainly due to lack of funding. In this assignment, we have been given permission to use some of the raw data that underpins this reporting.

The research that has been done on environmental impacts to date is modest, and does not really allow any overall and conclusive conclusions to be drawn, beyond the fact that mining is indeed causing impacts in places. Thus, there is a need for performing a sector wide study of impacts. Such a study should also include considerations for how to apportion environmental liabilities related to operations that have a history of being state owned (see below; mine legacies).

Nevertheless, several investigations have found that levels of heavy metals are elevated in areas downstream of mining: for example, in the Voghji and Geghi rivers in the south (Georgyan et al., 2013); and in the Debed river, downstream of Alaverdi (Kurkiyan et al., 2004). Mining related pollution is also reaching across the national borders, into the international Kura and Araks river systems (Ewing, 2003; Kurkiyan et al., 2004). Corroborating results are seen in the data collected from regular water quality monitoring which is being performed by the Environmental Impact Monitoring Center, where data analysis show that levels of copper in water are in some cases extremely high, and probably in places so high as to make it impossible for aquatic fauna to survive (Figure 7.3 and Table 7.2). Part of the reasons for the contamination include inadequate environmental management measures being undertaken at mine sites (Figure 7.4). Further, Acid Rock Drainage occurring in active, or recently active, mine sites were observed at several sites during the field visits (Figure 7.4).

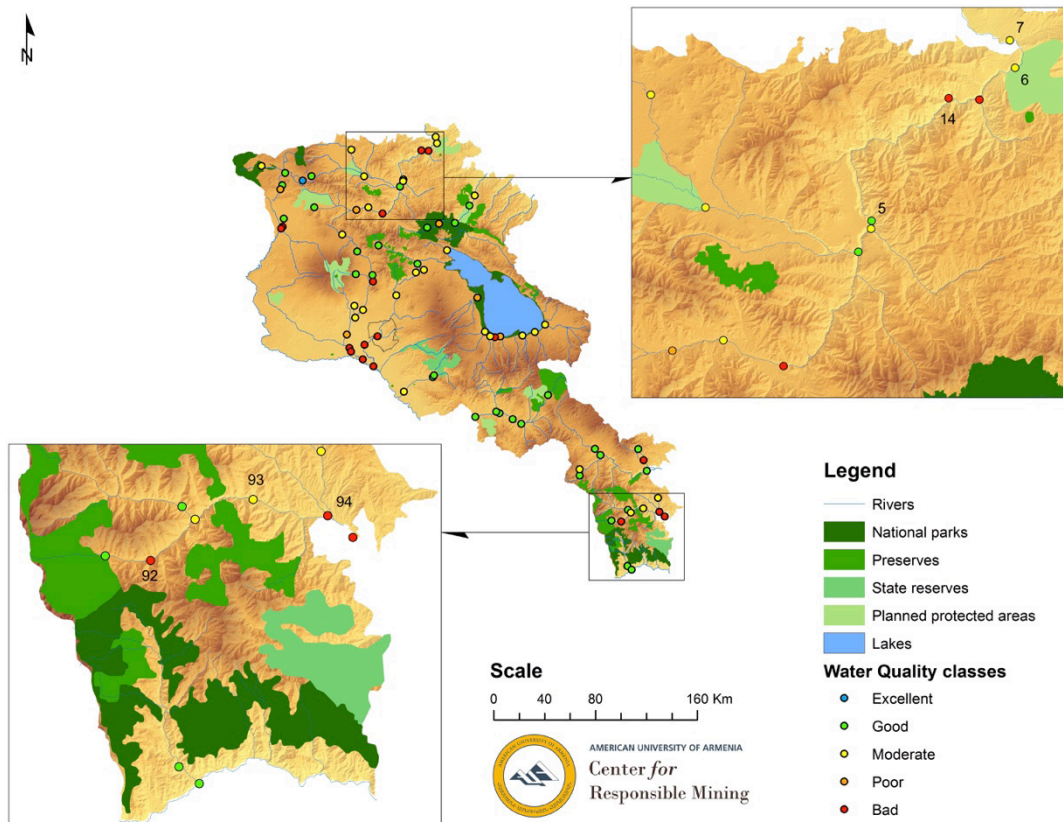


Figure 7.3. Map showing results of water quality monitoring in 2014. Note that water quality downstream of mining areas in Lori and Syunik are classified to be poor or bad.

Table 7.2. Cu concentrations in water (recoverable concentrations) at selected sites in the Debed and Voghji river systems during 2014. For the location of sites, refer to Figure 8.3. Note that sample sites 14, 6 and 7 are situated downstream of mining operations at Alaverdi area; that site 92 is downstream of Kajaran, and 94 is downstream of Kapan. The data are compared with USEPA water quality criteria for the protection of aquatic life, as well as with Armenian government set background levels for copper in respective river system.

Debed River, location no.:	5	14	6	7
Cu conc. (µg/L)				
Median:	3,5	86	10	10
33 percentile	4,3	186	13	11
66 percentile	2,9	31	9,2	8,4
n.:	12	12	12	10
Voghji river, location no.:	92	93	94	
Cu conc. (µg/L)				
Median:	8,0	5,5	52	
33% percentile	11	6,1	108	
66% percentile	7,2	4,8	40	
n.:	11	11	11	
<i>Background (Debed and Akhtala):</i>	3,0			
<i>Background (Voghji):</i>	4,0			
<i>USEPA, aquatic life (acute effects)</i>	4,6			
<i>Source: Environmental Impact Monitoring Centre</i>				

The EIA law, as well as the system for conducting and approving EIAs is new, and no firm conclusions can be drawn as to how well it may be working. However, a comparison of the Teghut environmental documentation for project approval, which predates the EIA law with the more recent Amulsar project suggest that the new system may deliver much better and more comprehensive assessments. The Amulsar EIA appears to have been produced in line with international best practice, but the reason from it having this higher standard may in also relate more to IFC requirements (as IFC has invested in the project), than requirements entailed in the new EIA law.

The new EIA law contains a range of sophisticated tools, including requirements to consider an analysis of ecosystem services. A recent UNEP/UNDP project has attempted to perform a pilot for such an analysis of a small gold mining project (Karaberd gold mine; UNEP/UNDP, 2014). The conclusions included that data availability was not good enough for a proper analysis to be performed. This is not surprising as very few successful examples of such ecosystem studies, or similar attempts to monetise environmental issues have been performed in an environmental policy, or EIA related setting, rather than in a more academic research related environment where several examples do exist. This experience exemplifies the conclusion in the legal chapter, which states that whereas the legislation that exists in Armenia is rather comprehensive and even sophisticated, the real problems lie in implementation, both in terms of practicality and ability.

Figure 7.4. Examples of land and environmental issues at active operations.



Mines requires access to land although the areas in question are almost never large compared to other land uses. Locally, however, mining is an intrusive form of land use (Kajaran left, Artsvanik right).



There are clear examples of poor environmental performances among Armenian mining companies. Tailings discharged to a stream (left); and a leakage in tailings channel (right; Syunik Province).



Tailings impoundments may be difficult to vegetate or to control in dry climate, and if managed poorly, this may result in dusting (Syunik Province).



Upstream raise tailings dam with signs of ARD in dam wall (Syunik Province).



Small mining operations are rather common in Armenia. Example of a small mine which appears not be active; and with signs of ARD (Syunik Province).

Serious contamination of agricultural soil and of ground in inhabited areas with heavy metals have been reported from Kajaran town (Gevorgyan et al, 2013), Alaverdi (Petrosyan (2004), Akhtala (Petrosyan et al., 2014) and Agarak (Ghazaryan et al., 2013). Possible sources of these elevated levels include dust and waste deriving from mining and processing, as well as from smelting activities. In Akhtala, Petrosyan et al. (2014) show that children's blood lead levels in this mining town are higher than other communities.

Overall, there is much concern over possible human health effects due to mining and processing. Alarming statements about lowered fertility among women, increased risks for cancer, and other ailments in mining affected areas are commonly made. However, with the exception for the studies of blood lead levels in children (above) there has been no studies or other investigations that show whether such fears and concerns are warranted.

Dusting from tailings deposits is a possible source of contamination and this was also observed during site visits performed in this study (Figure 7.4). The problems appeared to be rather serious in the south of the country, which has a more arid climate.

Pollution deriving from the Alaverdi copper smelter are well visible in monitoring data collected by the Environmental Monitoring Centre, where levels of sulphur dioxide well above maximum allowable concentrations (MAC) for protecting human health in extensive areas affected by downfall from the smelter.

7.4. Key socio-economic considerations

One characteristic of the minerals sector is that it can bring economic development and work opportunities to parts of countries that may have few other opportunities. This is the case in Armenia, as Syunik, in spite of being a comparatively sparsely populated province, still is the second most significant contributor to national industrial production (after Yerevan). The GDP per capita of Syunik is also similar to that of Yerevan, whereas all other provinces are comparatively significantly less well off. The main reason for this is the mining and processing operations (mainly ZCMC) that employ about 5,000 people in Syunik. Lori province is also a fairly sparsely populated region and its economy will have grown significantly with the newly opened Teghut mine.

However, most mines in Armenia are not large and profitable operations that create significant opportunities for work. In fact, most mines that are currently operating are small and many of them have been running at loss even through times of historically high metal prices. Such mines are unlikely to be able to contribute significantly to economic or other development now or in the future. This indicates that mining permits may have been granted without necessary requirements for the completion of appropriate feasibility studies. Further, due to the lack of profitability, these mines are more likely to become environmental liabilities as there are commonly not sufficient funds available for adequate technical development and environmental management (see below).

Larger mining companies often engage in Corporate Social Responsibility. This is also the case in Armenia, where the owners of the three biggest mines (Kapan, Kajaran and Teghut) are all engaged in CSR related activities. Importantly, these activities are in no way obligatory in a legal sense, although there appears to exist strong expectations that larger mining companies should engage in such activities.

Dundee Precious Metals reports on its activities in an annual sustainability report, which is written in GRI format, and thus provides a rather clear overview of the activities have been undertaken, as well as what size funds have been used for these purposes. The ZCMC, and Teghut companies (i.e. Vallex Resources) do not produce such reports, but some information is available on the companies' respective web site, and further information has been collected in various meetings during this assignment. Thus, in 2014, Dundee Precious Metals reports spending about USD0.5 million on nearby communities, and CSR related work. This in turn represented a bit more than 1 percent of the value of sales from Kapan. With regards to ZCMC, they report on these types of expenditures in the period 2006-09, when they also reached about 1 percent of turnover spent on community projects. The funds allocated (1% of sales) are in line with or even a bit higher than what is commonly seen for CSR programs at mines internationally. More recent data on ZCMC suggest that during 2013-2014 they spent about USD9 million on socio-economic, charity and community/state development projects.

Vallex and ZCMC's CSR related activities are generally performed in accordance with a philanthropic tradition, and share a number of characteristics in that both companies are focusing their activities locally, but that they also support organisations that are active elsewhere, or even nationwide (e.g support to the All Armenian Fund). Locally, support is provided to schools, sports organisations, health facilities and to efforts related to improving or protecting the local environment, or to rehabilitating buildings, infrastructure and/or cultural heritage.

Lydian International through its local Geoteam company is also involved in community development programs to three village communities in the vicinity of the Amulsar project. The company has until recently been in the exploration and project development phase, and during this time, efforts has been made to support the strengthening of local businesses so that they, in turn, can become suppliers to Lydian and Geoteam. Lydian has also conducted a rather ambitious social baseline study, that can support and inform the CSR related activities that are being conducted.

More important than CSR is generally what mining companies can do for the local community by em-

ploying local staff, and making purchases locally. Further, if real linkages can be made with the rest of the local or national economy, then the benefits brought by mining may be further increased. The fact that Dundee Precious runs operations outside Armenia, in Bulgaria, Serbia and Namibia, allows some comparison as to what extent local employment and local procurement is happening in Armenia (see box). These data suggest that whereas employment of local mine workers is taking place, there seem to exist opportunities within Armenia for interventions and / or support aimed at educating more senior people that may gain employment at a management level, as well as to build up local suppliers of goods and services to the mining sector.

BOX: Local content at the Kapan mine (2014) compared to other Dundee Precious operations

	Armenia (Kapan)	Bulgaria (Chelopech)	Namibia (Tsumeb)
Local nationals – workers	99%	100%	98%
Local nationals – managers	46%	100%	76%
Local origin - operating costs	38%	85%	95%
Local origin - CapEx	25%	65%	55%

Sentiments of communities affected by mining range from full support to full opposition. In some communities in the regions, jobs are badly needed and mine developments are therefore welcomed. But concerns exist that benefits from mining operations may be modest and finite, while environmental damage could be irreversible and long term. Proper, in depth community consultations appear to have been rare, and it is reported that the consultations often have taken place in the regional centres, rather than in the affected communities themselves. This way, villagers may then first hear only rumours about future plans, after which come visits from mining representatives where the decision is presented to the villages as one already made. A typical story reported in the news is one where the community says it has not been properly involved in decision-making, although there may have been some sort of consultations, and that the impact on the environment has been underestimated by state authorities. Such news stories also often portray the community sentiment as that of disenfranchisement where they do not believe they can influence any decisions made in any material way.

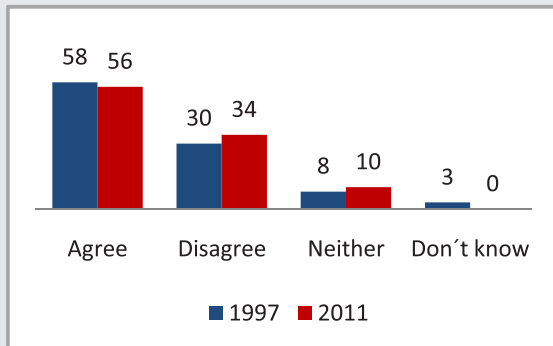
There are cases where the community voices its opposition has been both organised and forceful. The most known and most long-lasting activist campaign against a mining project is the “Save Teghut” civic initiative (c.f. section 3.3). Recently, community opposition to an exploration project in Lori (by Vallex, Lori province in 2015) caused the project plans to stall or at least be severely delayed. In this specific case, the community does not seem to have felt that exploration in any way was materially different from an actual mining project. Similarly, in 2011 an area near the Kajaran village was allocated to ZCMC. The area has been reported to include a village graveyard, as well as a church and several houses. Apparently, the decision was ostensibly made without prior consultation with the villagers. The head of the community then reacted by closing road access using his own car and he did not let any machines pass. The process is currently frozen.

As alluded to in the stakeholder chapter, decision making in Armenia is rather centralised and possibilities for local participation in decision making are small. For example, it has been suggested that with regards to planning and negotiations around resettlement and compensation during mine development, that these are largely agreed upon between developer and authorities, with limited involvement of community members or other affected peoples. Another example of central control is the environmental fees that are paid by mining companies, and which then may be allocated through subventions to affected communities, where the communities and the amount are subject to approval in the annual state budget.

The Armenian society may be described as fairly patriarchal, where men are supposed to be the breadwinners while women are supposed to be the caretakers of the family. In the Box below, World Values Survey (WVS) and Caucasus Barometer (CB) survey data illustrate some work-related gender stereotypes that exist in Armenia.

Box: Workplace-related gender stereotypes in Armenia

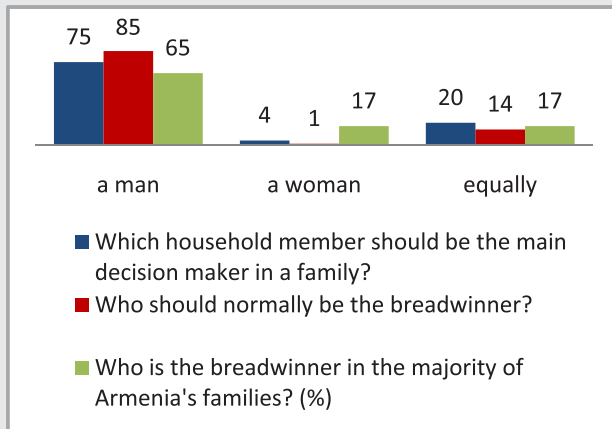
World Values Survey



Statement: When jobs are scarce men should have more right to a job than women.

In 1997, 58% agreed with this statement while 30 disagreed. In 2011, 56% of respondents agree that if jobs are scarce, men should have more right to a job than women, and 34% disagreed. Thus, the opinion distribution has remained remarkably stable over the past decade, almost within the margin of error.

Caucasus Barometer



Gender stereotypes in Armenian Society, 2010 (%)

An overwhelming majority of Armenians believe that the man should be the main decision maker and the breadwinner in a family. Although in reality the man is the main breadwinner (65% of cases reported in the survey), an even higher number (85%) of respondents think he should be so. This result is considered to be somewhat abnormal.

Mining is a sector which traditionally has brought opportunities in a disproportional way to males. This is still the situation practically everywhere, although attempts are made in some countries to improve gender equality. In Sweden, which at times is used as an example of a country where the goal of achieving gender equality is taken seriously, the state owned iron ore producer LKAB has only 18% females employed, with the percentage being lower among actual mine workers. In Armenia, there are no particular laws or regulations that limits women's involvement in the mining sector in Armenia. In fact, recent legislative development (e.g. the Law on Ensuring Equal Possibilities and Rights for Men and Women of 2013) suggest a real intention to work towards gender equality in all social aspects, including labour. However, the situation in the mining sector of Armenia is similar to elsewhere. For example, Dundee Precious Metals reports that their Kapan mine operation has a male/female ratio among employees of 83/17. The situation is unlikely to be different at other Armenian mines, confirming that work to improve gender equality is needed.

7.5. Mining legacy liabilities

Field visits suggest that many, if not most old and no longer mined sites in Armenia have been left without any significant rehabilitation measures having been performed. The problems relate to urgent security risks for human health (e.g. open adits, unfenced pits etc.), as well as to longer term environmental risks. This implies that the areas in are unlikely to be usable for any other future purpose, and thus possibly could represent a near permanent loss of land. This appears to be true in both the metal and non-metal mining sector (Figure 7.5).

The Armenian authorities (the MENR) see many of these sites as national assets, as they may be associated with mineral reserves. There is therefore a tendency of wanting to keep them “open”, to possibly attract new investors, instead of actively pursuing environmental remediation or rehabilitation.

Considerable work has been performed, mostly funded by the OSCE, concerning Armenian legacy sites. For example, an assessment of legacy sites in the Lori province has been produced, as well as a more in depth study of one specific site in Alaverdi (Hickman and Pardini, 2014; National Academy of Science – The Center for Ecological-Noosphere Studies, 2010). Much of the work is focused on waste materials, and these are treated in depth in Chapter 8 of this report.

Overall there is a need to make an inventory of legacy sites, to assess their respective risk, and to develop a prioritised list for rehabilitation and/or remediation. Such programme has been performed in numerous countries, but one of the most ambitious, well known and long running example is the US CERCLA-Superfund initiative, from which much can be learned (see box). The work could draw upon the inventory of abandoned mines performed by the GRA in 2004-2009, with financing provided from the RA State budget.

Box: Rehabilitation of legacy mine sites – the US Superfund

The Superfund program was initiated in 1980 and it is a US Federal government effort to clean up land that has been contaminated by hazardous waste and that has been identified by the US Environmental Protection Agency (EPA) as a candidate for clean-up because it poses a risk to human health and/or to the environment. Initially a fund of nearly USD2 billion was created using taxes imposed on major oil and chemical companies. The fund has subsequently been replenished on a number of occasions.

The EPA works with various stakeholder and authorities to identify hazardous waste sites, test the conditions of the sites, formulate clean-up plans, and to decontaminate the sites. Abandoned mine lands form a large part of the Superfund sites. It is estimated that there are some 500,000 abandoned mines in the USA.

Many developed countries have established similar hazardous waste remediation programs. Some countries pay for site clean-up from general government revenues (taxes, etc.), whereas others rely on special taxes on industry (similar to Superfund).

Source: www.abandonedmines.gov

Most of the now operating metal mines have a history of being state run enterprises. Thus, the environmental liability that is associated with these operations should be shared between the state and the current owner. To our knowledge, no such division of liability has been performed (although this may be part of the privatisation contracts which, in turn, are confidential). For example, the Kajaran mine and associated waste and processing facilities had a more than 50-year history as a state run operation, before it was privatised and taken over by ZCMC. A process is needed whereby division of

liability is performed, and the results of which should be made public (when state assets are privatised, such a process is fair, correct and necessary). The only two major projects where the environmental liability lies completely with the current owner is the Teghut mine, and the Amulsar project. The above facts regarding apportioning of liability are important to remember when one considers needs and responsibilities for environmental rehabilitation, and mine closure (below).

The present funds deposited in the Nature Protection and Reclamation Fund, and which are meant to be used for rehabilitation after closure of now ongoing metal mining operations, represent about USD2 million. Whereas the establishment of such a Fund is the right approach to ensure that there are no new environmental legacies created, the amount deposited is inadequate for the rehabilitation of even one of the more substantial and now operating mines. The problem appears to lie both in the rationale of how the fund is constructed, as well as in the amount of money that has been paid into it. As a comparison, the corresponding fund in Sweden (with a metal mining sector about 4-5 times that of Armenia - 90 million tonnes of ore compared to Armenia's 20 million tonnes) has a current value (end 2015) of USD400 million, that is 200 times larger than the corresponding Armenian fund. In Sweden, the funds deposited are directly tied to the estimated cost of closing an operation at the present time. In Armenia, the money in the fund is a part payment of the cost to close the mine at a time in the future, which is set by the estimated life of mine. This provides inadequate protection for the event of early closure.

The question of what the former state owned mines should be made to pay into the Nature Protection and Reclamation Fund is complex. Ideally, the apportioning of environmental liability should have been part of the privatisation agreement. In the ZCMC case, the state should then have set aside part of the proceed of the sales to ensure that it could cover this liability. This appears even more crucial as to date, ZCMC has deposited practically no money at all in the Fund, with one offered rationale being that it is a mine with a near perpetual life. Thus, it will not be closed any time soon, and it is not necessary to deposit any funds for closure. This is a rather naïve preposition, given that although the Kajaran is a large and impressive deposit, the mine has already gone through hard times, when it was under care and maintenance (in the early 1990s). As a comparison, the considerably larger Aitik copper mine in Sweden (also with a substantial life of mine remaining) has deposited more than USD200 million to cover for future closure costs.

Figure 7.5. Examples of mining legacy issues



ARD forming and lack of rehabilitation at a former mine site (Syunik province).



Waste pushed out from adits, and left without efforts to remediate or reclaim the site (Syunik province).



Seemingly abandoned tuff operations, with no remediation having been done (near Yerevan).

7.6. Recommendations

Overall, the knowledge and understanding of the nature and causes of the environmental impacts of current mining activities is not good enough to be the basis for policy decisions. A comprehensive sector wide *Sectoral Environmental Impact Study* (SEIS) is needed. The SEIS should consider impacts that relate to both pollution stocks (legacy sites) and flows (ongoing mining). The SEIS should also provide a basis for the apportioning of environmental liability between the state and the current owner mine operations that have a history of having been state run.

There are significant environmental stocks/liabilities left from former mining operations, with at least some of these being in urgent need of rehabilitation. The needs in this regard include the following:

- a. The current knowledge of where the sites are situated, and what kind of risks and levels of risk they represent is inadequate. Thus, there is a need to make an inventory of these sites, to assess their respective risk, and to develop a prioritised list for rehabilitation and/or remediation (such work is to be well coordinated with efforts addressing mining waste, and that are considered in chapter 10, and included in the suggested SEIS above).
- b. The reason that some sites are left without remediation may have to do with them being seen as state assets, that should be protected to facilitate possible future investments and economic development. Decisions need to be taken as whether this type of rational really is adequate and suitable, as it is a way of thinking that is uncommon in other mining countries.

Significant impacts are caused by ongoing mining operations, and it is clear that a key step towards an environmentally sustainable mineral sector is for mining companies to simply "do better". Initiatives to contribute to a better performance may include the following:

- a. Encouragement of private sector initiatives, including the establishment of a Chamber of Mines, where firms voluntarily commit to certain standards. The performance of smaller mine operators may be especially important in this regard, as part of the reason for their overall poor performance may be a lack of expertise and knowledge, both of which may be partly addressed by membership of a larger professional body.
- b. Improve supervision and control, as well as making environmental penalties for noncompliance more severe.
- c. Strengthening and/or encouraging the role and possibilities for CSO and/or local communities to monitor, and report to authorities regarding mining company transgressions.

Given that there are only a few larger ongoing or planned mining projects (ZCMC, Teghut and Amulsar), there may exist scope for one of these to take on the role of being an "agent for change". Notably, the World Bank has supported one such initiative in the Indian state of Odisha, where a large state controlled mining company was supported to become a reference and agent for change (see box below). However, there are limitations in this possibility as in the Odisha case, the company is state controlled, and in Armenia, the companies are privately held and there is little that the government or any other body can do to force a company to take on this role of doing "more". However, there may exist mechanism whereby such a role may at least be encouraged. For example, IFC and EBRD funding could be made conditional of becoming, to some extent, such an agent for change.

Box: Benchmarking Odisha Mining Corporation as a Change Agent

The World Bank Group has supported the Indian state of Odisha through different programmes for sustainable development of the mining sector. A method used to implement reforms, was to identify Odisha Mining Corporation (OMC) as a “change agent”. OMC is major and state controlled company, mainly engaged in iron and chrome mining. The World Bank supported a benchmarking and strategic planning exercise for this company, with the aim to introduce global good practices into OMC which then, in turn, would raise the bar and motivate other companies to follow suit. Five main tasks were included in the benchmarking exercise:

- (i) Operational Benchmarking against a representative set of peer companies. Actions were identified for OMC to reach alignment with the peer group in terms of production, cost structure, production control, IT, product quality, SHE etc.
- (ii) Mineral Resource Assessments - to ensure a full understanding of OMC’s mineral resource base (existing mines and undeveloped mineral resources).
- (iii) Scenario Analysis - different scenarios were defined based on internal and external factors, and longer term commodity price trends.
- (iv) Strategic Prioritization for Development which was based on the results of (i), (ii) and (iii), where production projections and investment needs were modelled and developed. The prioritization included investment plans, cash flow projections and analyses of NPV for relevant projects.
- (v) Review and Recommendations, which included a number of strategic production and investment plans as well as business models.

The funds available for closure and remediation of mine operations (the Nature Protection and Reclamation Fund) are inadequate, even for the rehabilitation of one of the more substantial of the now operating mines. There is thus a need to ensure that payments into the fund are substantially increased, and that the funds deposited by any one current operator and former owners (including the state) are sufficient to cover closure costs at a given mine at the present time. That is, the fund should be tightly bound with a requirement by companies to at regular intervals produce costed, and up-to-date closure plans.

In terms of the communities that live nearby mines, challenges remain in ensuring that these have possibilities to participate in decision-making and impact assessments that existing laws and regulations stipulate. International experiences show that NGOs and CSOs often hold significant environmental and socioeconomic knowledge and they can therefore contribute to ensuring a sound development of the mineral sector. This role can be performed not only as the traditional “watch dog” role, but also with NGOs being a resource for capacity building and training in mining communities. Such building of capacity and awareness in communities may facilitate meaningful participation in project planning and monitoring, as well as in negotiations with developers around resettlement and compensation, and contribute to conflict prevention. Thus, mineral sector development would benefit from fostering an environment where civil society is encouraged to participate in the development of policy and laws and in the management and control of the sector. The CSOs must, however, first be strengthened in terms of their knowledge and understanding of the sector.

8. Mine waste management

8.1. Introduction

Mining creates more waste than any other industry, in Armenia as well as globally. Adequate mine waste management is therefore often the most important issue with respect to ensuring protection of human and environmental health in mining areas.

The emphasis in this assignment is to consider mine tailings, but it is important to realise that there are a few different types of mine waste:

- a. Overburden is the barren surface soil or rock that needs to be removed to gain access to the ore in open pit operations.
- b. Waste rock is the material surrounding the ore body that does not have any economic value but that needs to be removed along with the ore body as part of open pit or underground mining operations. While waste rock is not mineralised in an economic sense, it may still have a mineral content that needs to be considered in environmental management (for example pyrite that can give rise to ARD). Overburden and waste rock can be stored in specific waste dumps for later use at site restoration.
- c. Tailings are the waste product of mineral processing operations and range from sand to clay-sized particles produced after crushing and grinding of the ore for the purposes of mineral extraction. Tailings are often transported in slurry form and deposited in stand-alone tailings storage facilities (TSFs), often referred to as tailings dams.
- d. Barren heap leach material is formed of crushed (coarse) or agglomerated (fine) ore that remains in place after leaching of the ore within a heap leach pad has been completed.
- e. Acid Rock Drainage (ARD; see explanatory box in chapter 8) treatment sludge is generally formed by the addition of lime to ARD, resulting in a very low density sludge of metal hydroxides. If ARD is treated during the operational phase of a mine / mineral processing plant, it will normally mixed with tailings and will be stored in a TSF.

The key risks for mining waste storage facilities, in general, can be categorised into i) those associated with environmental performance and ii) those associated with physical instability. Environmental risks are mainly related to: the presence of hazardous materials in the mine waste (e.g. cyanide, process chemicals, various metals and metalloids); materials with the potential to become hazardous (e.g. oxidation of sulphides leading to ARD); and the presence of fine particles, mainly in the tailings. Table 9.1 summarizes hazards, potential environmental impacts and typical mitigations methods used in mine waste management.

The focus on tailings when considering mining waste facilities is often well motivated since tailings can be highly mobile under conditions of physical instability. Such physical instability may occur via: (i) dam wall failure or (ii) overtopping. There are several triggering mechanisms for dam wall failure, and include seismic events, high pond water levels, overtopping events themselves, high rates of rise (RoR; where the dam wall is increased at a rate that is too fast) and various design factors (e.g. inappropriate wall angles, poor ground investigation of foundation conditions). Recent examples that illustrate the risk involved include the catastrophic failures of the Mount Polley TSF in Canada (2014, with environmental impacts) and the Samarco TSFs in Brazil (2015, with both environmental impacts and loss of life).

Table 8.1. Key environmental hazards, potential impact and typical mitigation measures for different types of mine waste facilities.

Facility	Hazard	Potential primary impact(s)	Typical mitigation (risk management)
Waste rock dump	Storage of waste with ARD potential	Contaminated seepage into groundwater (dissolved metals)	Low permeability liner, perimeter barriers, mixing ARD waste with neutralising waste
Waste rock dump	Storage of waste with ARD potential	Contaminated run-off into surface water (solids and dissolved metals)	Low permeability liner, perimeter barriers, mixing ARD waste with neutralising waste
Waste rock dump	Airborne dust (contaminated or non-contaminated)	Human and animal health (inhalation) Soil contamination (solids)	Surface covers
TSF	Storage of contaminated materials (process chemicals in tailings and/or tailings with ARD potential)	Groundwater contamination	Low permeability liner, perimeter barriers, bulk flotation of ARD minerals for separate storage
TSF	Storage of contaminated materials (process chemicals in tailings and/or tailings with ARD potential)	Contaminated run-off into surface water (solids and dissolved metals)	Surface cover
TSF	Discharge of tailings pond water to surface water environment (process water chemistry)	Surface water contamination (solids and process chemicals)	Recycle pond water to plant, pond water treatment prior to discharge
TSF	Airborne dust (contaminated or non-contaminated)	Human and animal health (inhalation) Soil contamination (solids)	Surface covers
BHLP*	Storage of spent (leached) ore	Groundwater contamination	Already lined
BHLP	Airborne dust	Human and animal health (inhalation) Soil contamination (solids)	Surface covers (if required)
ARDTSF**	Seepage	Groundwater contamination	Maintain ponded

*Barren heap leach pad

**Acid Rock Drainage treatment sludge facility

The impacts associated with physical hazards (instability) for mining waste storage facilities are commonly discussed both in terms of the potential for loss of life as well as environmental impacts. With regards to risk levels associated with physical instability and loss of life, these also depend on the proximity of the waste storage facility to occupied areas.

The design of TSFs that are used to store tailings (usually in slurry form) is critical to the risks associated with physical stability. Two design examples, upstream raise and downstream raise, are summarised in figure 8.1 in order to illustrate this criticality. Upstream raise dams are cheaper to build than downstream raises but are much more likely to fail as a result of seismic activity, poor pond water management and instability induced by a too high RoR.

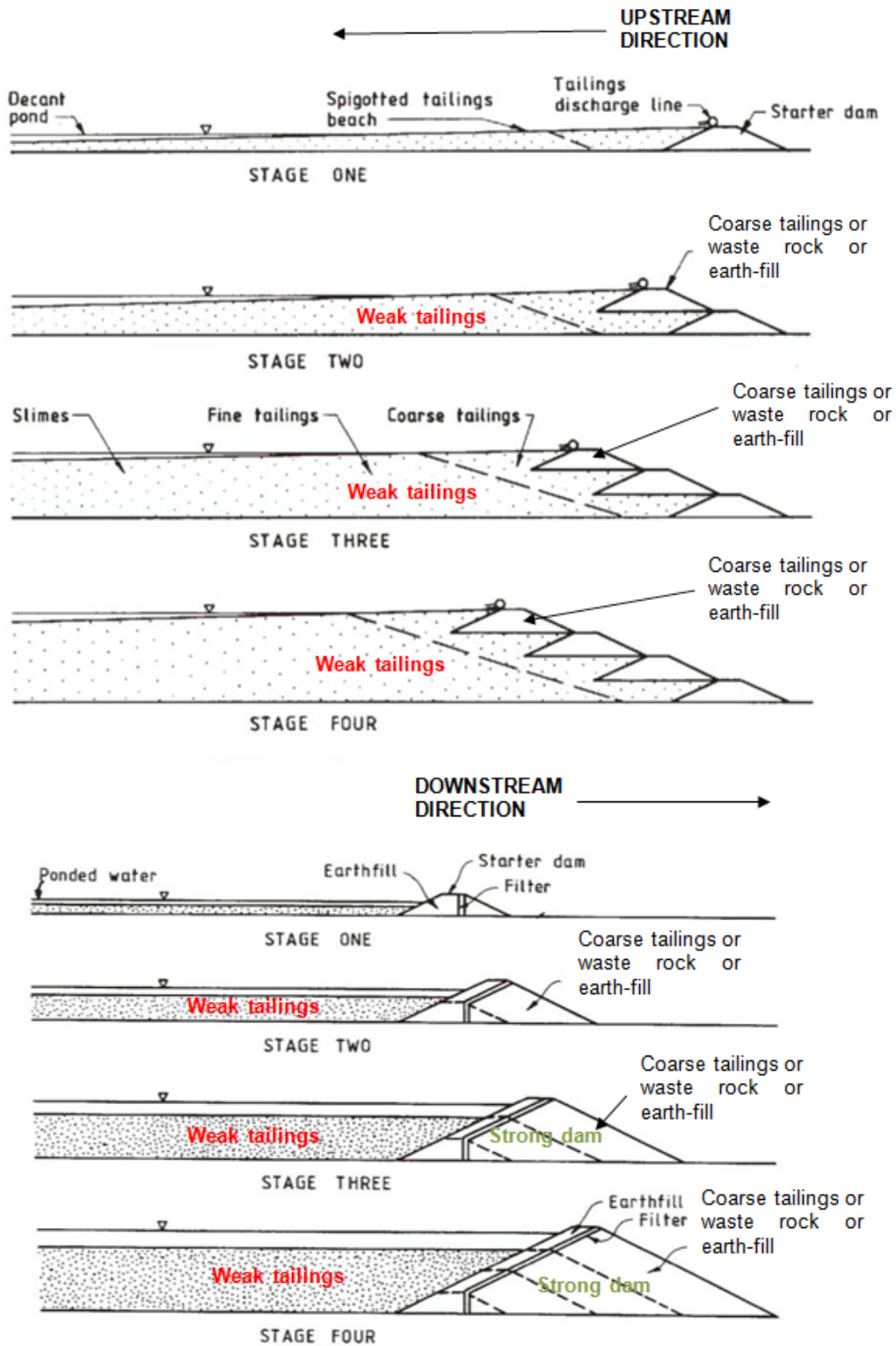


Figure 8.1 Schematic illustration of upstream and downstream raise tailings dams.

In any country where the mineral industry is adequately regulated (i.e. where proper laws exist and are implemented), there is a clear business case for implementing best practise mine waste management. This follows from the large costs associated with poor environmental performance and in particular with catastrophic failure of tailings dams. Environmental remediation and other liabilities can in such cases potentially lead to a significant erosion of the company's market value, and the suspension of operations. Thus, the cost of best practise tailings management is generally considered to be worth the reduced risk of significant incidents.

8.2. Mine waste baseline

There are 21 tailings dams in Armenia, of which 13 are active and all but two are located in the Syunik or Lori regions (Table 8.2). ZCMC's Artsvanik dam is by far the largest of the active dams, with a current actual volume that makes up almost 75% of the volume of all tailings. The recently commissioned Teghut dam is also designed for large volumes, corresponding to almost 30% of the designed volume for all dams. Other dams are much smaller than these two, and most are in fact very small structures. There is one heap leach operation today in Armenia, the GPMs Ararat plant, and a second one would be constructed should the Amulsar gold project materialize.

Within this assignment, 7 of the active dams and 4 of the closed dams have been visited. The overall assessment of mining waste storage facilities (both operational and non-operational / abandoned) revealed that the physical stability risks posed by tailings dams are far greater than those posed by waste rock and overburden dumps. This also appears to be true with regards to environmental risks. This section therefore focuses on tailings facilities. It should however be noted that the issue of waste rock is not insignificant to judge from brief observations made during the field visits. Improperly designed and located waste rock dumps with potentially ARD generating material were observed at least at one of the visited active mines.

Table 8.2. Tailings dams in Armenia with information as per 1 January 2014; nd=no data (modified from table produced by the Centre on Sustainable Development of the Yerevan State University).

	Tailings dam name	Province	Deposit & metals mined	Status	Volume, designed (mln m ³)	Volume, actual (mln m ³)
1	Artsvanik	Syunik	Kajaran (Cu, Mo)	active	310	270.0
2	Voghji	Syunik	Kajaran (Cu, Mo)	closed (1977)	30	19.4
3	Pukhrut	Syunik	Kajaran (Cu, Mo)	closed (1969)	6.0	3.2
4	Daradzor	Syunik	Kajaran (Cu, Mo)	closed (1961)	4.0	3.0
5	Geghanush	Syunik	Shahumyan (Cu, Pb, Zn, Au)	active	11	5.8
6	Artsvanik's area	Syunik	Kapan (Cu)	closed (2008)*	1.1	1.0
7	Agarak-1	Syunik	Agarak (Cu, Mo)	active	9.1	1.0
8	Agarak-2	Syunik	Agarak (Cu, Mo)	active	17.9	7.0
9	Agarak-3	Syunik	Agarak (Cu, Mo)	active**	40.9	38.6
10	Dastakert	Syunik	Dastakert (Cu, Mo)	closed (1968)	3.1	1.5
11	Terterasar	Syunik	Terterasar (Au)	active	nd	0.03
12	Hanqasar	Syunik	Hanqasar (Cu, Mo)	active	2.5	0.04

	Tailings dam name	Province	Deposit & metals mined	Status	Volume, designed (mln m ³)	Volume, actual (mln m ³)
13	Alaverdi	Lori	Alaverdi (Cu)	closed	0.5	0.4
14	Akhtala-1	Lori	Akhtala, Shamlugh (Cu, Pb, Zn)	active	3.2	1.1
15	Akhtala-2	Lori	Akhtala, Shamlugh (Cu, Pb, Zn)	closed (1988)	0.5	0.4
16	Akhtala-3	Lori	Akhtala, Shamlugh (Cu, Pb, Zn)	closed (1989)	0.4	0.3
17	Armanis	Lori	Armanis (Cu, Pb, Zn)	active	nd	0.08
18	Mghart	Lori	Mghart (Au)	active	0.1	0.08
19	Teghut	Lori	Teghut (Cu, Mo)	active***	180	nd
20	Tukhmanuk	Aragatsotn	Tukhmanuk (Au)	active	1.5	0.2
21	Ararat	Ararat	Sotk, Meghradzor (Au)	active	20	12.5

**In operation 2004-2008 in area of the Artsvanik tailings dam.*

***reported as active in the original data source (as of 1 January 2014); not in operation at site visit in November 2015.*

****Started operation in the beginning of 2015.*

Tailings dams in operation

Detailed reviews of 4 of the largest active tailings dams have been produced (the facilities numbered 1, 5, 14 and 19 in Table 9.2, representing nearly 80% of the total designed volume for Armenia's existing tailings dams, see Appendix 2). The dams reviewed include both old dams constructed during Soviet times, and a new dam that was designed and constructed recently (Teghut, no 19).

None of the dams reviewed (or visited) are in line with international best practice, neither in terms of their design nor their management. Importantly, all major tailings dams visited has been constructed using the upstream raise design. This is a design which according to best international practice is considered to be unacceptable in seismically active regions (see box). It is further noted that in some cases, the impact and consequences of failure of existing tailings dams could be severe, including the loss of life as several dams are located upstream of communities or areas of human activities, such as agriculture.

Box: Why not use upstream raise design in seismically active regions?

The upstream raise design for tailings impoundments is an often used way of construction tailings impoundments. However, experiences of wide spread failures of dams constructed in such a way during earth quakes, for example in Chile during the 1970s, has shown that the design entails a too high probability of some form of physical instability issue occurring under seismic loading. Such instability issues may also occur due to poor tailings pond water management.

In some jurisdictions where seismic hazard is high, the adoption of upstream raises is now prohibited under law (e.g. Chile, Peru). In general, this TSF disposal method is being regarded as being unfavourable for medium to high hazard TSFs and is not being accepted by some authorities in countries with a well-developed mineral sector (e.g. Ghana).

In relation to the risk for communities, it was also revealed that although some emergency plans exist within the companies themselves, such emergency planning which also includes considerations for the communities at risk are lacking.

The majority of the tailings come from copper-molybdenum or base metals mines (copper-lead-zinc +/- gold) with sulphide mineralization. Thus, there is a general risk for ARD formation and the spread of potentially metals and arsenic to the environment. ARD was noticed at several (but not all) of the locations visited during the field visits undertaken within this project (see in figures 7.4 and 7.5). The large Artsvanik tailings dam (no. 1), and possibly also the Geghanush dam in Syunik, do not seem to have a significant ARD problem. However, investigations are necessary to ascertain whether such issues may appear in the longer term.

The use of the upstream raise method has limitations in cases when tailings with ARD potential is being stored. This follows as such a dam needs to be a "leaky dam", that is water from within the tailings must be allowed to escape, so as not create a too high water table within the structure, with associated risks for dam collapse. When water is allowed to leak from a dam containing ARD generating waste, the seepage must be collected and/or treated. This does not occur at neither of the dams that contain ARD generating waste (c.f. reviews for dams no. 14 and 19 in Appendix 2).

As a result of the dramatic relief of the Armenian mining areas, the tailings dams have often been placed in steeply incised valley. This means that the structure needs to seep not only through the walls of the dam construction itself, but also through the sidewalls, to avoid instability issues for the tailings that abut onto the valley sides. Such seepage through the sidewalls is a potential route for ARD to enter the environment, and in contrast to the bottom of a TSF, it is not generally possible to apply a liner to sidewalls. The Teghut TSF is, for example, a potentially ARD generating facility which situated in a steep valley. Although it is lined at the bottom, this may not be sufficient to prevent potential leakage of ARD on the sides of the TSF.

Dusting from tailings dams was observed during field visits, and was also stated as a problem by several informants. Dusting is a rather common environmental issue in mining areas, and one which may be difficult to combat. However, reclamation and cover of old tailings would reduce the problem, as would ensuring that tailings are moist (which also reduces the potential for ARD formation), and concurrent rehabilitation of dam surfaces. Some modest attempts to perform concurrent rehabilitation of dam surfaces are being pursued.

Overall, there seem to exist a realisation among the major Armenian mine operators that existing tailings dams are problematic. Thus, it was revealed that international experts have been retained to review and assess the tailings dams of some of the major operators (ZCMC, Dundee Precious and Teghut). Further is also clear that the construction and permitting of TSFs have been done without adequate risk assessment, and this point at serious gaps both in terms of the technical capacity retained by the companies themselves, as well as a regulatory gap. Regarding the regulatory gap, the exact process for the approval of dam constructions is not clear. Dam design and risk assessment are part of a company EIA, and the Ministry of Territorial Administration and Emergency Situations is responsible for regulation and risk assessment in this regard. According to key informants, however, the Ministry does not house capacity for this. It was furthermore stated that the former state institution that held specific expertise in dam design has been privatised, and now forms part of the Vallex group, where it has a minor and seemingly increasingly less important role to play in company affairs.

Non-operating tailings dams

With regards to old mine waste, environmental risks are commonly more of an issue for tailings than other types of mines waste. This follows as the risk for failures of such facilities decrease when they are no longer active. In contrast, the risk of ARD emanating from abandoned waste rock dumps increase with time, and this is often the key long term environmental risk for these types of structures.

Field reviews of tailings dams that are closed or abandoned, revealed that these were constructed in what at the time was the most cost effective methods available, following then accepted criteria. While there are rather severe limitations to the design and practices used, it should be acknowledged that the practices used were similar to international practices at the time. Also, the very fact there was a recognition of the need to store the waste rather than simply dispose of it (which was a rather common practise in many countries at the time) is positive.

Similar to the situation for active tailings dams, several of the non-active dams are located upstream of settlements and old tailings dams are also used for agriculture and grazing without any prior risk assessment having been undertaken to assess potential presence of hazardous substances and exposure pathways.

There is no evidence of any ambitious attempts at closure for the old tailings facilities, with one exception in Akhtala where EU funds were used to perform some fairly modest rehabilitation measures (see 8.3 below, and Appendix 2).

8.3. Management and rehabilitation of mine waste facilities

Possibilities for waste minimization

Short of major developments in the areas of metals recycling and reprocessing of tailings materials, mining will continue to produce large amounts of waste, which are costly to manage, and for which there is today no significant alternative use. Thus, focus need to be on waste minimization, and the high costs for depositing and managing is in itself an incitement for companies to minimize waste.

Box: Why no environmental tax on mining waste?

Taxes may be charged to create income to government, or as a means to discourage/encourage certain behaviours (or a mix of the two). Environmental taxes are used to address environmental challenges. For example: carbon taxes are used to promote a shift away from fossil fuels; tax on waste are used to encourage waste minimisation and recycling; and in Sweden, a tax has been used successfully to promote the use of crushed rock instead of natural gravel and aggregates, thus helping preserving an important natural resource.

Mining waste (waste rock and tailings) is the dominant waste stream in all countries that have a substantial mining sector, yet none of these countries have chosen to introduce a tax on mining waste. The reason lie in the fundamental characteristics of how mining and processing is performed. First, the product sought (e.g. the metal) is present in small concentrations in the mined ore (from percentages to grams per ton), which means that in what ever way the process is run, the vast majority of the treated ore will end up as waste. Second, given that the removal of waste rock and processing of ore are costly, there are very strong economic reasons for mine operators to reduce the amount of material moved and crushed, irrespective of whether there is a tax on waste or not. Third, due to the characteristics of the waste produced by a typical mine, the possibilities for secondary uses of the waste are nearly always severely constrained (e.g. due to regulations on metal levels in material used as aggregates, or due to the very fine grain nature of process tailings).

The above reasons mean that if a tax on mining waste is introduced, it will essentially only mean that the cost of mining will increase, and that fewer project are viable. That is, it is not waste production that is discouraged but rather the whole activity of mining. Such a result, if sought, may be achieved by other already existing means; for example, through an increase in the royalty paid.

Environmental regulation may motivate the application of best practise and best available technology with the aim to minimize the production of waste. While various tax instruments are also sometimes used to regulate industry towards improved environmental management, including waste minimization, countries with a significant mineral sector find no justification for imposing a tax on mine waste (see box above). This is also currently the case in Armenia where the Law on Environmental and Natural Resource Use Fees and the Law on Rates of Environmental Fees impose tax on industrial waste, while of mine waste is excluded from this tax.

In fact, the law prescribes that a tax or environmental fee should not apply to the disposal of non-hazardous mining waste (c.f. section 4.6). This could then mean that these types of waste are considered to be non-hazardous, while there is actually no existing system in Armenia for the classification of (mining) waste into hazardous and non-hazardous. Such a system is needed for companies to assess how waste should be treated and stored and for the authorities to be able to regulate the industry.

Rehabilitation and closure of old TSF

From the desk-top work and field visits within the current project, it is apparent that all non-active tailings structures in Armenia require impact investigation and probably, in most cases, some level of risk and impact mitigation works. The fundamental stages in a developing and implementing a robust mitigation plan are presented in the table below.

Table 9.3. Basic stages for the development of mine waste mitigation plans.

	Stage	Components / Comments
1	Preliminary investigation and review of need	Site visit by competent persons to identify hazards and allow definition of data gaps and detailed investigation requirements. Preliminary conclusions of mitigation requirements based upon site visit observations, initial (basic) sampling and testing and desk-top review of available data. Design of more detailed investigation works and costing thereof. Prefeasibility level costings ($\pm 25\%$) of best-estimate mitigation measures. Submission of recommendations report to Competent Authority.
2	Approval of mitigation project	Competent Authority (CA) to review the recommendations and to take a decision on whether or not to proceed with the mitigation proposals. Identification of funding sources and options.
3	Detailed investigation and sample analysis	Undertaking of site-based investigation work. Likely to involve the drilling of boreholes and/or other techniques for the recovery of samples and installation of monitoring instrumentation. Subsequent laboratory testing likely to include analysis of water samples, ARD potential of tailings.
4	Design of mitigation measures and production of cost estimates	In accordance with the findings of risk assessments that are based upon the findings of the detailed investigation and the application of best available techniques for mitigation works. Definitive feasibility level cost estimates ($\pm 10\%$) for the proposed works.
5	Preparation of contract documentation and tendering	Preparation of bill of quantities (BoQ), conditions of contract (CoC) and specification. Selection of appropriate contractors and preparation of bid package on behalf of CA. Independent review of tendered bids and recommendation of preferred contractor. CA to engage contractor and supervising engineer.
6	Implementation of mitigation measures	Supervising engineer to oversee the works, ensuring compliance with specification and carrying out Construction Quality Control (CQA) of works.
7	Monitoring, review and maintenance	<p>Implementation of monitoring scheme to determine the efficacy of mitigation measures. Monitoring scheme normally reduces in frequency with time as effectiveness is demonstrated. Ongoing maintenance is required to ensure success of restoration vegetation in first 2 – 5 years after which self-sustainment is normally achieved.</p> <p>Some mitigation measures might require one-off maintenance at longer time frames e.g. refurbishment of acid wetlands at 10 to 20 years, replacement of anoxic limestone drain material every 5 to 10 years. However, the goal is for supplementary mitigation components such as these to be obsolete beyond the short to medium term as the efficiency of the primary mitigation measure(s) (such as a low permeability cover system) should be designed to fully mitigate the issue within this timeframe. For example, there will be a time lag between the placement of a cover system and the significant reduction in ARD seepage since there will be a slow draw-down of the groundwater levels within the TSF after placement of the cover with an associated reduction in ARD seepage rates to acceptable levels that do not require subsequent supplementary treatment.</p> <p>In terms of physical stability, monitoring of groundwater levels and / or dam wall settlement / movement is carried out until target steady state conditions at demonstrable levels of stability are achieved.</p>

It is important that any mitigation plan is robust and has a high probability of success. This necessitates high quality investigation, design and implementation. The rushed implementation of poorly conceived and designed plans has a high probability of failure and funds spent are often wasted.

Such a situation is exemplified by the case of the Akhtala-2 tailings dam (see assessment sheet in Appendix 2). The Akhtala-2 tailings dam stopped operating in 1988. We are not aware of any initial rehabilitation works at the time of closure, while the dam was covered with soil in 2010 in order to “prevent dusting and reduce environmental impact” and in 2012, 700 saplings were planted on top of the dam through the EU Waste Governance - ENPI East Project with aim of halting erosion and run-off.¹⁰ It appears as if a proper investigation, resulting in adequate mitigation measures, was never undertaken, and at the site visit within this project, no healthy saplings or trees were observed.¹¹

Typical mitigation measures for abandoned TSF, and associated illustrative costs, are provided in Appendix 3. Our estimated costs for the development and implementation of relevant mitigation works for Akhtala-2 is provided in Table 8.4.

Table 8.4. Estimated costs for mitigation planning and implementation for the Akhtala-2 tailings dam, Lori Province (see Appendix 3 for detailed assessment).

Stage	Cost (USD)	Comments
Preliminary investigation	11,194	Use local consultants/scientists as far as possible. There is a requirement for the involvement of international experts.
Detailed site investigation	44,048	Includes drilling, sampling, installation of sampling wells / piezometers, laboratory testing (geotechnical and environmental), supervision costs, factual report.
Risk assessments and mitigation design	36,413	Use local consultants/scientists as far as possible. There is a requirement for the involvement of international experts.
Contract documents	6,975	Use local consultants/scientists as far as possible. There is a requirement for the involvement of international experts.
Mitigation works (contractors)	475,805	Main works: GCL cover, restoration soils cover, runoff control channels, anoxic limestone drain, stone columns.
Mitigation works (CQA / supervision)	19,094	Use of local engineers.
Monitoring, review, maintenance	122,000	20 years, with reducing requirements over time. Discount rate of 3% applied.
Overall Total	715,500	

The cost estimates above are based upon currently available data that is incomplete, and more accurate costs for mitigation can only be determined via more detailed studies. For Akhtala-2, it cannot be concluded at this stage that the ARD and stability risks are high enough to warrant all of the proposed mitigation works. If the GCL, ALD and stone columns are not required, the total costs would reduce by around US\$ 260,000 for the contracting costs alone. It is possible that the ARD mitigation measures could be eliminated at the preliminary investigation stage (following initial water quality sampling), further reducing the overall costs associated with ARD risk assessments.

¹⁰ https://www.youtube.com/watch?v=89UXQ_j-Sok; <http://hetq.am/eng/print/20793>

¹¹ A likely reason is that the soil cover is not thick enough and the roots reach the tailings, which tend to have high sulphate (salt) levels. Salts can also rise into the cover soils as a result of infiltration and subsequent evaporation within the vadose zone (semi saturated zone). To be successful, one would need to plant appropriate species that can tolerate high salt levels.

In any case, the required costs in the case of Akhtala-2 would constitute a significant part of the current funds available in the Nature Protection and Reclamation Fund (about USD2 million), which are under consideration for use for the purpose of rehabilitating old tailings dams. Considering the fact that Akhtala-2 is the second smallest of the closed dams in Armenia (other dams hold 2-50 times the volume of Akhtala-2 (table 8.2), and depending on the actual mitigation works that will be needed for other dams, total costs for the restoration of all closed dams will likely amount to several million, and possibly some 10s of million USD (cf. Box below with examples from Sweden).

For the establishment of a national plan for mitigation works and closure of “abandoned” mine waste facilities in Armenia, all facilities would need to go through a preliminary investigation (i.e. steps 1-2 of table 8.3). Looking at some eight “abandoned” tailings facilities, this would alone cost on the order of USD 1 million, while actual total costs would only be known after the design of mitigation measures (step 4, table 8.3).

Box: Remediation costs for old mines – examples from Sweden

The Swedish EPA (SEPA) has since the late 1980s been involved in efforts to rehabilitate old mine waste sites. In 1998, SEPA reported to have spent about USD30 million on such work, and it then estimated that to address the next 27 priority sites would entail a cost of USD100 – 200 million.

The Adak Cu/Au/Ag mine was operational 1940-1977 when some 6.3 million tonnes of ore was treated. In 1998, Swedish government funded a project to apply a dry cover to the tailings site, including subsequent monitoring. The costs to date have amounted to about USD3 million and the needs for monitoring will continue essentially in perpetuity.

The Gladhammar Fe/Cu/Co mines in southern Sweden were abandoned as early as in the late 1800s. Before state funded remediation was undertaken in 2011, the mines caused leakages to a downstream lake of 430 kg Cu, 125 kg Co and 60 kg Pb annually. In 2011, one mine adit was closed, and about 70 000 ton of waste were treated, which almost stopped all the contamination emanating from the site. The cost for the project was about USD7 million.

Source: Swedish National Audit Office, 2015

Active and new TSF – management and rehabilitation

The poor performance of the four operating tailings dams assessed within this project (including for example occurrences of ARD and dusting, and risks for physical instability; see above), shows that international best practise for tailings dams construction and management need to be adopted in Armenia.

Thus, new tailings dams’ facilities in Armenia should move away from the upstream raise design. Attention is here drawn to the recent conclusions of the investigation report into the high profile Mount Polley TSF failure in Canada in 2014. The Mount Polley expert panel has produced a much stricter set of BAT (Best Available Technique) suggestions, which go beyond discussions on different types of dam designs (e.g. upstream versus downstream raise), and include the phasing out of hydraulically-placed tailings altogether (i.e. slurry tailings).¹²

¹² Sometimes, tailings are dewatered to such an extent at the process plant (via vacuum or filter presses) that they are referred to as ‘dry’. These can be ‘stacked’ in a TSF that is not considered to be a dam. Tailings can also be co-disposed (mixed) with waste rock in a combined mining waste storage facility and can also be deposited within exhausted open pits. The coarse fraction of tailings is sometimes separated out and used as backfill in underground mine operations.

With regards to currently active tailings dams, constructing new dams for the placement of old tailings is often not economically viable, and it would also be associated with environmental risks as large amounts of potentially hazardous materials have to be moved. The closing of active upstream raise dams and the construction of new adequately designed dams may however be considered, although this would also be associated with significant costs. Short of constructing new dams, engineering solutions to improve current designs are necessary. For example, for the Dundee Precious Metals' Geghannush dam, there is a proposal (advice and design by international consultants) to construct a new dam wall of rockfill downstream of the current dam wall in order to increase the stability of the overall downstream slope. This will apparently change the fundamental TSF design from an upstream raise to a centre-line raise, a design with less risk for physical instability.

To increase the environmental performance of operating dams, environmental issues need to be adhered to so as to minimize the occurrences of (or risk for) discharge of mine waters into the surrounding environment (see Chapter 8 for impacts on surface waters from mining), formation and impact from ARD, and also dusting. Many of the measures commonly applied for rehabilitation of abandoned facilities (Appendix 3) may also be applied in ongoing management of active dams. Measures can be relatively costly, for example on the order of USD30,000-80,000 per l/s for measures to intercept contaminated seepage, and USD 50,000-200,000 per hectare for seepage treatment systems (Appendix 3).

In cases where companies (or the government, when they carry liability as is the case in Armenia) have limited finances, it would be of importance to do a detailed cost-benefit analysis prior to any decisions around mitigation measures are taken, rather than trying to solve all problems with measures that are not fully adequate. For example, if ARD and mine water seepage pollutes water resources to such an extent that people's health is at risk, addressing this issue would be more important than measures aimed at mitigating other issues with less impact.

Possibilities for reprocessing tailings materials

The retreatment of tailings is a possible "win-win" scenario, in which potentially problematic tailings facilities may be profitably "re-mined". In the gold mining sector, tailings projects are rather common, whereas for other metals, they remain rare. A review of the Raw Material Data (2013) database on the world's copper and gold producers reveal that there was only one such tailing processing operation for copper (running at a grade of about 1% Cu), whereas there were at least half a dozen gold producers that were reprocessing gold tailings (at production costs varying from USD800 – USD1000 per oz).

Whilst there can be reductions in environmental and societal risks if poorly-designed mine waste facilities are re-worked for their mineral content, it should also be noted that old TSF that are not used are usually more stable and associated less geotechnical and environmental risk than active TSF.

There are examples of projects where tailings are reprocessed partly for environmental reasons, rather than only for economic gain. A pioneer project in this regard was the Kasese cobalt project in Uganda, which in its initial stages of development obtained financial support by the World Bank (see box below). Similarly, in Canada, a sector has developed where companies are engaged to reprocess tailings deposit as a means of achieving an environmental "clean-up" and where the costs of doing so may in cases be subsidised by the government.

Box: Kasese Cobalt - Successful reprocessing of mine waste through bioleaching

In Uganda, the Kilembe copper mine was in operation from the 1950s up to 1977 with a total production of some 16 Mt of ore at grades of about 2% Cu and 0.17% Co. Cobalt was only recovered up to the late 1950s and pyrite and cobalt rich concentrate (80% pyrite, 1.4% Co) from the flotation were then stockpiled for potential later processing, which however never occurred during the life of the mine. Thus, in this case, the material constituted a specific flotation component initially considered as a resource, but which turned into abandoned waste over the years.

The Kasese Cobalt Company Limited (KCCL) started reprocessing of the pyrite tailings in 1999 through using an innovative bioleaching process, developed specifically for this project (it is still the only cobalt bioleaching operation in the world). Investments costs amounted to some USD150-160 million and the operation produces high grade (99.9%) cobalt. In 2012, KCCL produced about 600 tons of cobalt, and at full capacity, the production rate is about 720 tons per year. The operation also includes a 9.9MW hydropower plant in a nearby river, and a limestone quarry with lime being added to the process for pH control and to precipitate dissolved iron.

Prior to the KCCL operation, acidic waters drained from pyrite stockpiles straight into the adjacent Queen Elizabeth National Park (right side of road in map below). Through the reprocessing of the tailings and treatment of mine water, the tailings are now contained, the potential for ARD mitigated, and the operation shows the potential for an economic feasible (and even at times profitable) solution to a serious environmental liability from past mining.



Google Earth image showing a) pyrite stockpile; b) ARD capture from stockpile; c) bioleaching and water treatment plant area; d) new contained tailings; e) water control pond; f) old (pre-KCCL) impacts from acidic water discharge.

As explained elsewhere, the Armenian Mining Code concept of “manmade mines” is used in cases where the mineral reserves contained in a waste deposit has been defined. Thus, companies are by law obliged to report amounts of tailings and metal concentrations to the authorities, in order for such reserves to be determined. This set up does implies an interest on part of the authorities to facilitate tailings retreatment projects. However, the whole exercise of defining “manmade mines”, and in defining reserves is unnecessary, as the allocation of such deposits need not be different from other exploration and mining projects, see above). Internationally, there are many companies that specialise in retreatment of tailings. The application for, and allocation of rights to mine such deposits is generally made in the same way as are rights to explore and mine. This follows as a tailings project is not too different from a mining project. It must, in the same way go through an exploration phase (i.e. determining grades and amounts, and the character of the material) before plans can be made for actual re-mining/re-processing.

With regard to tailings with a high content of sulphide, such as those that exist in Armenia, re-processing can be done through using flotation, followed by bio-leaching with bacteria. Some “back of the envelope” calculations on the typical costs (capex and running costs) of reprocessing tailings for either gold or copper using this technique are shown in the box below. They reveal that the grades that would be necessary for meeting costs of “re-mining” a 1Mt tailings deposit (there are about 10 deposits over this size in Armenia) through flotation followed by biox treatment) would need to be well in excess of 2% per copper, or 2.5g/ton of gold. These are high grades, which are unlikely to be encountered. However, for larger deposits, of which there are some in Armenia, the required grades would be less.

Box: Flotation and biox treatment of sulphide rich tailings

"Back of the Envelope Calculations"

TYPICAL CAPEX

Flotation cell: USD1M per 100tpd cell
 Biox (100tpd): USD10M

TYPICAL RUNNING COSTS

Flotation cell: USD50/ton
 Biox (100tpd): USD200/ton

e.g. 1Mt tailings, 2000tpd flotation plant, and flotation/biox of 20:1

CAPEX:	(\$1Mx20) + \$10M:	\$30M
RUNNING COST:	\$50x1Mt + \$200x0.05Mt:	\$60M
	total:	\$90M

Required copper grade to meet costs (% at \$4,500/ton Cu):	2%
Required gold grade to meet costs (g/t at \$1,100/oz Au):	2.5

source for CAPEX and running costs: BachTech

No detailed studies have yet been undertaken in Armenia to investigate the possibility for the reprocessing of tailings material in Armenia. However, the Centre for Sustainable Development at the Yerevan State University (CSD-YSU) has implemented a project to assess the potential for reprocessing of tailings, and they have made some calculations that appear promising. As the CSD-YSU have not been granted the right to sample tailings materials, these estimates concentrations based on published information on metal concentrations in ore and the efficiency of extraction methods used. This is not

sufficient for decision-making around the possibility for reprocessing of tailings, as rather extensive drilling and sampling across tailings dams would be required to firmly establish reserves and the economic viability of “re-mining”. In this regard, one informant mentions a company that considered the case of the Artsvanik tailings, while they left the idea when rough estimates pointed at a Cu concentration of 0.1%, at which level reprocessing would not be economically feasible.

The Armenian government’s interest in promoting re-processing of tailings has not ended with the definition of “manmade mines” in the RA Mining Code. In 2015, a specific law was passed where the Artsvanik, Pkhrut and Voghji tailings dam is handed over to the Government for the purpose of contracting out the rights for the reprocessing of the tailings (RA Law HO-102-N of 23/06/2015). This is a unique measure, which has no international comparison, and leaves a number of questions to be answered (see box below).

Overall, even though the term “man-made mine” is defined in law, there is considerable confusion as to what the concept of “man-made mines” entails, specifically regarding ownership and assumption of environmental responsibilities as the regulatory framework for the ownership and liability (and transfer thereof) of tailings is not clear. Further, as long as there is lack of knowledge on value contained in tailings (ore grades), no projects will go further.

Box: Reprocessing of Artsvanik, Pkhrut and Voghji tailings – why and how?

The first project for reprocessing mining tailings in Armenia is provided for by the “Law on an investment project to process industrial dumps accumulated and being accumulated in Voghji, Pkhrut, Artsvanik tailings as well as industrial dumps produced and being produced by Zangezur Copper Molybdenum Combine CJSC (Syunik region)”.

The purpose of the law is to: establish legal guarantees for the implementation of the project; defining and differentiating the scope of liabilities of the State regulatory and local self-government bodies, and the rights and obligations of the implementing party related to the investment project; defining ownership for the tailings. Thus, the law provides for granting the right to the tailings to a “third” implementing party through a contract between Government, the Implementing Party and the ZCMC (with the latter now holding the rights to the tailings and the associated responsibilities for environmental management). According to the law, the implementing party is exempted from all applicable taxes and other mandatory payments related to the transfer of the rights of the tailings. Further, the respective mine tailings mentioned in the law are themselves pledged as guarantee for the potential liability caused during the implementation of the project.

The enactment of this law has caused concern among some stakeholders. Questions asked include the more fundamental – why the need for a specific law, as well as more detailed concerns regarding the economic viability of the project, who will end up taking on the environmental risks and liabilities, and whether, there is a large risk for the Government to end up with a significant environmental liability which should, rightfully belong to the former owner of the tailings in accordance with the “polluter pays” principle.

Speculation around the potential for reprocessing of mine waste may create expectations that cannot be met in the near future, and to consider mine waste as ore (mineralization that is economically feasible to extract) is premature. Further, it would be irresponsible by the State to assume ownership of TSF that may become large environmental and economic liabilities. In the meantime, it is vital that proper TSF management is implemented by companies, including rehabilitation as needed to protect the environment and people.

8.4. Recommendations and road map for approach to tailings management

A well run (sustainable) minerals sector is one where adequate management ensures that contamination from waste sites do not escape beyond site perimeters, and where waste facilities do not represent significant risks to surrounding communities and/or land uses in terms of accidental spills or geotechnical failures. Furthermore, there must be adequate funds built up to ensure the orderly closure of the waste facilities once mining ceases. Where there are legacies from the past, there should exist an active government run program of risk assessment and subsequent remediation of prioritised pollution stocks. None of the above described circumstances prevail in Armenia today which means that strategic interventions are needed. These interventions need to be based on a thorough understanding of the present situation.

All major tailings dams in Armenia are constructed in accordance with the upstream raise design. This is an inappropriate design, and not in line with international good practice in seismically active as they are prone to failure during earthquakes. This issue is made more serious by the fact that some large tailings impoundments are situated nearby downstream communities. Risk assessments of all major dams are therefore needed, and appropriate actions need to be taken (e.g. redesign, or strengthening of facilities). Furthermore, there is a need to establish plans of how to manage and mitigate residual risks. Such plans should include emergency planning for nearby communities.

Several of the tailings impoundments in Armenia are potential sources for ARD. The upstream raised design entails a need to collect, and treat the seepages. It also implies a need to line tailings, to stop seepages to groundwater. This appears not to be done at any of the larger facilities. There are further substantial problems and challenges related to the operation, and design of existing tailings dams. There appear to be some realisation of this fact, as several of the larger operators have recently retained international experts to review designs, and to suggest improvements. Closely related to the issue of ARD, it is proposed that a system for the classification of mine waste into hazardous or non-hazardous be established in Armenia. This is commonly based on mine waste leaching tests for which there exists well developed standards in a number of countries.

In terms of the regulation and control of dam designs by the authorities, there is little expertise available within Armenia, and the process by which designs for tailings facilities are permitted need to be reviewed, and substantially improved.

The funds available for closure and remediation of mine operations are inadequate. It will be necessary to ensure that payments into the fund are substantially increased, and that the rationale of how the fund is set up is revised. Furthermore, as many of the now operating mines have a history of being state run operations, a part of the liability and responsibility for ensuring that they are safe, may accrue on the Armenian government (depending upon the agreements made during privatisation, c.f. the findings and recommendations of Chapter 8).

There may be some possibilities for retreating some of the existing tailings impoundments, and in this way addressing both environmental issues and creating economic opportunities. However, for this occur, proper site investigations need to be performed, and it is suggested that this may be done by private operators, in the same way as is the case with exploration and mining. Thus, there is no need for special treatment in law, neither in the defining of these deposits as “man-made mines”, nor the enactment of special laws for the exploitation of specific sites. Furthermore, it is important to ensure that the “polluter pays” principle is followed, and that the state does not unwittingly take on substantial environmental liabilities, which rightfully belong to private owners and/or operators.

In terms of old and no longer used mine waste sites, these are creating substantial contamination, and may also in some cases represent risk for failures. There have been some initiatives taken to assess, and also remediate at least one site. However, there is a need for a government led and funded pro-

gramme to be established, which entails risk assessment and subsequent remediation of prioritised pollution stocks.

Overall, there is a dearth of experience and knowledge of how to design and manage tailings impoundments, and this is true both within the mining companies as well as within government. For government, capacity building and training is urgently needed, and this must also be associated with an effort to close the regulatory gap that now exists in terms of permitting, and controlling tailings facilities. Similarly, among the companies there is a need to improve capacity. In this regard, a private sector led initiative of how to best design, build and operate tailings impoundments would be useful. For such an initiative to become reality requires the establishment of a business interest group, such as an Armenian Chamber of Mines.

9. Summary sustainability assessment and recommendations

This concluding chapter presents a basis for how the sustainability of the mining sector may be considered (9.1), and built on this, makes an overall assessment as to what extent mining in Armenia can be seen to be contributing to sustainable development. This is performed by summarising the findings of the report, and considering these findings through the concepts of economic, environmental and social sustainability (9.2 – 9.5). The summary assessment is followed by recommendations for actions to be taken to improve the situation. These recommendations are, in turn, divided into actions to be included in a process of establishing a mining policy for Armenia (9.6); and actions that need to be taken irrespective of the outcomes or timing of the process of policy development (9.7).

9.1 Basis for sustainability assessment

How to best define sustainable development is a contested subject (e.g. Kolk, 2016), and the concept’s applicability specifically to minerals extraction has been challenged given that such activities involve the extraction of non-renewable - although near indestructible - resources (e.g. Whitmore, 2006). Nevertheless, the three components that commonly is said to underpin sustainability – that is environmental, social and economic – form a useful framework in which to assess the performance of the Armenian minerals sector (Figure 9.1). This in spite of assertions by some that businesses or other activities that reach true sustainability, represented by the area in figure 9.1 where all spheres of sustainability intersect, are rare in any modern, industrial or post-industrial society.

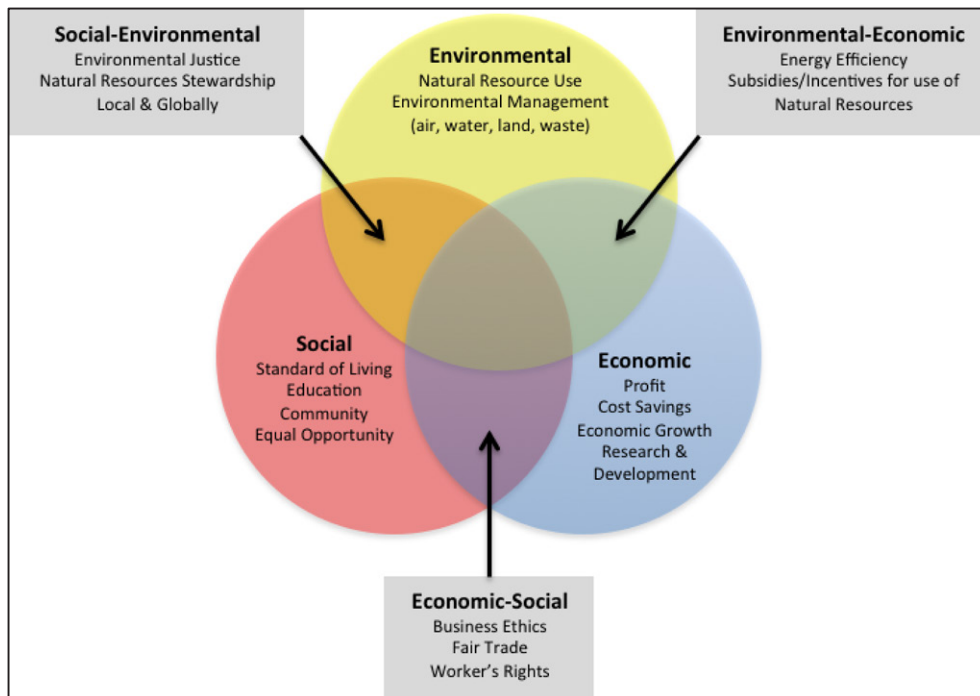


Figure 9.1 Illustration of the three spheres of sustainability. A truly sustainable project / initiative will be positioned in the area where all (environmental, social and economic) sustainability criteria are met.

A sustainable minerals sector is one where the environmental impacts caused are well managed, and where contamination from operations do not escape beyond site perimeters. The operations must not

represent a significant risk to surrounding communities and/or land uses in terms of accidental spills or geotechnical failures of waste facilities. In terms of social issues, operations should enjoy overall support by the local populations (a “social license”). The economic performance should be strong and reliable to ensure operational continuity, and the economic benefits accrued should be equitably shared, so as to create opportunities and development. If it is a large operation, such developments should occur over regional or even country wide scale.

9.2. Economic sustainability

The mining sector is shown to be an important contributor to the Armenian national economy, above all as a source for export incomes, foreign direct investments, and for creating relatively high paid work opportunities outside of urban centres. It is further shown that it is better at providing tax related incomes to the state compared to most other sectors.

However, the sector is in terms of production and value created dominated by the ZCMC’s Kajaran mine, as this is the only “large” operation that exists. There are also a small number of mines that may be referred to as medium scale (e.g. Agarak, Kapan-Shahumyan, Teghut, Sotk). In addition, there are numerous operations in both the metals (about 10) and non-metals sector (about 500) which are all small, and rather insignificant in terms of their contributions to national welfare. The fact that the Armenian minerals sector is dominated by one single operation, makes it vulnerable to possible external shocks (e.g. changes in commodity prices and/or accidents and emergencies) and thus threatens its longer term sustainability.

Economic data from the last 5 years made available by the MoF suggest that only two, or three, of the existing metal mining operations have been making regular and stable profits (including the dominant operator, ZCMC). The less profitable (or loss making) companies notably include most, if not, all small companies that hold mining licenses. Mining operations that commonly make losses, cannot be seen to be sustainable from an economic point of view. Thus, it appears that mining permits have been granted for unviable projects. This finding is made even more significant in the light that the last 7-8 years represent a period of historically high commodity prices. Further, this poor economic performance has been happening at the same time as inadequate resources have been invested in pollution prevention, and environmental management (c.f. above).

Armenia’s geology, that is the rocks that underlie the country, are prospective for mining. With regards to metals, there exist opportunities for copper and gold mining, and also other metals. With regards to industrial minerals, there is a great variety of rocks that can be utilised. However, the mining and exploration related activities that take place today are to a dominant extent based upon the work performed during Soviet times. There has been very little in terms of new exploration, and new finds made in the last few decades. This lengthy period with no geological research and prospecting activities can, in turn, lead to their eventually being insufficient known resources and reserves that can sustain the sector. This in itself threatens the economic sustainability of the sector, but also, given the relative importance of the sector, the Armenian economy as a whole.

Forming linkages with other sectors of the local economy represents a good way of enhancing economic performance and sustainability. Findings suggest that although linkages and “local content” exist, there could be considerable scope for increasing the participation of local and Armenian businesses within the wider mining sector. Importantly, the roles that may be assumed by local entrepreneurs can also include more knowledge based services, such as technical consulting, and services related to geological exploration.

9.3. Environmental sustainability

With regards to metal mining, none of the existing operations can be seen to be environmentally sustainable. The main problems relate to:

There are a significant number of small companies involves in poorly managed brown field “exploration projects” (which appear to often assume the nature of small scale mining projects,) that are concerned with mineralisation discovered (and corresponding reserves established) during Soviet times, and these are creating substantial damage to the environment;

there is significant ongoing pollution emanating from existing mines and processing activities, both to air and water;

there is an overall lack of adequate plans and funds to enable reclamation and rehabilitation of mine sites, and associated waste facilities. What exist in the “Nature and protection and reclamation fund” is inadequate for its purpose, and in cases when the operations have had a history of being state owned (before privatisation) there has been no formal division of liability between the state and the new owner;

given the high seismic risk, and overall high risk for land instability, there exist excessive risks for waste facility collapses and/or accidents, caused by the inappropriate method of construction (the use of “upstream raise” designs) that is used for tailings impoundment construction;

in the non-metal and metal sector alike, mined out areas are commonly left without any significant efforts made for rehabilitation and reclamation.

Environmental laws and regulations that could potentially address most, if not all of the above problems exist. However, either these laws are not properly implemented, and there are significant problems related to legal ambiguity and of laws not being streamlined. There are also concerns that the fines and consequences for not being in compliance with existing environmental laws are, in fact low and do not constitute a sufficient deterrent. Further, among many companies, especially the smaller ones, there may be a lack of knowledge of laws, as well as a poor understanding of what is required in order to be compliant with laws.

Furthermore, the existence of a large number of no-longer mined, or no longer used mines and waste facilities which have no legal owner, represent a very significant environmental liability. Such facilities are causing significant and ongoing environmental damage. There may exist opportunities for economic re-mining/reprocessing of some of these sites although experience from other countries suggest that the bulk of the liabilities will need to be addressed by government through rehabilitation and mitigating measures. Some legacy sites are left without remediation or rehabilitation, as a result of the authorities’ ambition to preserve existing mineral reserves.

9.4 Social sustainability

The social component is possibly the most difficult component to assess. This is in part due to the fact that the social challenges that exist in the mining sector are inexorably linked with more general challenges that exist in the wider Armenian society.

Mining operations are providing jobs and livelihoods, and they do so in many areas where other economic opportunities are scarce. Further, in some communities, especially in Syunik, support for operations among local communities appears to be relatively strong. At the same time, one cannot say that there exist a widespread “social license to operate” for miners in Armenia. This lack of widespread support can, in turn, be seen to be rooted in real shortcomings on environmental and economic issues (see above). A prevailing culture of secrecy that is prevalent in the sector (on part of both companies

and authorities), hinders meaningful public participation as well decision making that is based on true and factual information. Initiatives to make such data publicly available for public scrutiny are therefore needed. In a similar vein, initiatives are needed to address the sometime seen cases of conflict of interest related set ups where current or former elected politicians engage in mineral project development.

Although there exist a substantial number of qualified mine workers in Armenia, there appears to be a lack of persons with more advanced skills (engineers, geologists, mining economists etc.). The lack of local management capacity is representing a constraint to the social sustainability of the operations. Similarly, women are severely underrepresented in the sector. This does not only represent a waste of skills and abilities, but also undoubtedly contributes to less well balanced and less well functioning work places, and mine communities.

9.5. Summary assessment

Overall, none of the existing metal mining operators in Armenia can be said to be in line with all three components of sustainability, and available evidence suggest that the same is likely to be the case for the majority of the non-metal mining operations in the country. Further, there are examples of operations that appear unviable in terms of all three components of sustainability, and this is appears to especially prevalent among the smaller operators in the metal mining sector. The reasons for the shortcomings are found in a mixture of failings, including companies' irresponsible behaviour, as well as failures by the institutions that are charged with supervising and controlling these activities. Some failings in the regulatory framework are also of importance as a reason for some specific failings, although the overall conclusions is that what exist in terms of laws and regulations is fairly comprehensive and ambitious, and although the regulatory system suffers from problems related to ambiguity and lack of streamlining between different laws, the main problems relate to a failure of implementation of laws.

Importantly, it is suggested a significant part of the overall controversy that surrounds mineral related projects in Armenia is caused by a lack of understanding and data, and also a lack of knowledge of best practice and technology in modern mining activities. With regards to the former, the ongoing work in preparing an EITI candidature application, and the work that is entailed in the subsequent implementation of the EITI standard will contribute substantially to establishing a better understanding of the sector. With regards to technology, there may exist considerable opportunity introduce more modern, safer and environmentally more friendly technologies in the sector. A further consideration in this regards relate to the suitability of SME involvement in the mining sector. Whereas the exploration field and possibly also some forms of quarrying and dimension stone extraction constitutes suitable areas for SME involvement and development, actual metal mining and processing may be one of the least suitable sectors for such SME participation. This follows as such activities, if they are to be done properly, require longer term management and stewardship, as well as access to considerable resources and funds to operate a mine, also in times of lower commodity prices or after accidents and/or mishaps.

In conclusion, data show that mining is important to Armenian society, but it also suggest that individual operations are not generally contributing sufficiently to the longer term sustainable development of the nation. This is in spite of a range of past and ongoing initiatives taken by the Armenian regulators to reform the sector. These initiatives have, however, been taken without reference to a policy or longer term strategy. Thus, this report's main recommendation is to urgently embark on a process of developing a national mining policy (9.6). Such a process will take at least one year to complete, and it is strongly recommended that the process for developing said policy is coupled with the efforts made in making Armenia an EITI compliant country. Whilst the process of policy development is ongoing, it is recommended that non-urgent reforms and legislative developments aimed for the mining sector are

put on hold. There are, however, some priority actions and initiatives that are needed irrespective of the outcomes of policy development, and recommendations for these are also provided (9.7).

9.6. Development of an Armenian mining policy

The world's commodity markets are presently depressed, with generally low prices and low demand. However, the mining sector is cyclical and sooner or later, there will be an upswing in the market, and new investment will follow. Thus, the present is a fortuitous time for mining policy development, to ensure that when the next wave of development and investments arrives, Armenia will be well prepared to manage the various challenges and opportunities that such times entail.

There exist a number of initiatives that assist countries in developing mining policies (e.g. there is a wide range of recommendations and policy documents published by the World Bank, and think tanks such as IGF, IISD, NRGJ etc.), and these can all serve as useful inspiration and references for the development of a policy for Armenia. The main point of having a policy is that it helps in ensuring that development and regulation of the sector holds together, and contributes to the achievement of an overall vision for national development. Furthermore, the process of developing a policy is important in itself as - if it is done well and in a participatory way - it provides an opportunity to build consensus and a shared understanding of issues among affected stakeholders.

It is suggested that the development of the mining policy be based on a vision for the characteristics of a future Armenian minerals sector. Bearing in mind the results of the present assignment, and the fact that Armenia is committed to becoming an EITI candidate country, the broad vision could include that the sector needs to contribute to sustainable and equitable economic development; that benefits should be shared at the national level, whilst ensuring that communities that are directly impacted by minerals related projects are not adversely affected economically or socially, and not either exposed to excessive risks related to possible emergencies or accidents.

In establishing the vision, it would be helpful to paint a rather concrete picture of what the sector could look like. For example, based on the findings and recommendations of this report it is suggested that the future situation could be one where there are fewer mines and quarries but that these have considerably larger production than today. Further, the operations should be more mechanised and modern and performing in an environmentally responsible way, and with adequate concerns for health and safety of their workers. In addition, there should at any given time exist advanced exploration projects, in turn based on the outcomes from an active and innovative exploration sector. The sector as a whole need to be supported by linkages to local businesses and consultancy companies and all of these should to a dominant degree hire well qualified Armenian staff that have had the opportunity to receive high quality training both locally and internationally.

Basic questions that may be addressed in the process of policy development include which type of mines (commodity, size, ownership, etc.) can meaningfully contribute to sustainable development goals; what economic development (national, regional, local) related to mining shall be promoted; what shall be the roles and responsibilities of the state and the companies and their owners. These types of questions can be addressed through the formulation of a small number (no more than about 10) of policy statements, which together contribute to achieving the overall vision. These statements are the commitments by government, and they could address a number of issues, as exemplified in Table 9.1.

Table 9.1 A non-exhaustive list of policy issues that may be addressed in a mining policy for Armenia.

Issue	Example of questions to be addressed in Policy
Role of government vs. role of companies	How should the responsibility for mining community welfare be allocated; Should government have a role as operator and/or owner of mines?
Foreign investments and ownership	Should ownership/control of licenses by foreign companies/individuals be free or in some way be restricted?
Allocation of rights to explore and mine	Who can hold rights to mine and explore, and how should rights be allocated?
Conditions and regulations that pertain to the metals vs the non-metal sector; and SME versus large scale operations	Should the same rules apply to all ventures, whatever the commodity and whatever the size of operations? To what extent should conditions for how mining and exploration is done be governed through contracts, or regulations?
Public participation / transparency	To what extent shall data on mining and exploration activities be made public?
Value addition, local content and linkages	Should there be requirements for utilising locally sourced staff and equipment?

The development of the policy will, in a similar way to the EITI process, provide an opportunity for broader cooperation/interaction between institutions, as well as among civil society and private companies. Thus, it is suggested that the process for policy development be coupled to the EITI process, and also that it is managed in a similar way. Thus, it is suggested that there could be an implementing group, chaired by the Ministry of Finance (or PM), and including the sector ministries and authorities that are most concerned (MoENR, MoE, MoNP). The consultative process should include CSOs, private companies, local community representatives from mining districts, as well as central and regional authorities. Although it may be both prudent and useful to coordinate efforts with the EITI process, for example through making use of the multi stakeholder group, this must be done whilst being mindful of the risk of this causing disruptions and/or delays to the EITI process.

The implementation of the policy, once completed, should include a number of diagnostic studies, that will fill the knowledge gaps that exist, and thus ensuring that policy implementation is done whilst having a true and reliable understanding of the current situation (the baseline). The diagnostic studies, will also serve to identify the means and measures (technical, financial, human resources) necessary for achieving the policy. The following diagnostic studies are recommended, most of which may to an extent build upon the findings of this present report:

Sectoral Environmental and Social Assessment

Assessment of the main environmental and social issues, and provision of practical proposals for how any negative issues identified can be addressed, and positive development opportunities facilitated. In such a study, considerations for how to apportion environmental liability in operations that have previously been state owned may be addressed.

Geotechnical risk assessment

Identification and description of the risks represented by existing geotechnical structures and methods for design used in Armenia.

Proposals for possible regulatory changes to reduce any identified excessive risks, and including assessment of feasibility.

Economic assessment

Assessment of different types of mining projects' economic viability, including those championed by SMEs. Assessment of different types of mining projects' contribution to local, regional and national economies.

Technology assessment

Assessment of the technology used at various mining projects in Armenia, with the aim to identify areas where increased mechanisation and/or better management may be required.

Health and safety review

Assessment of health and safety concerns at various mining projects in Armenia, with the aim to identify areas where increased mechanisation and/or better management may be required.

Institutional review

Assessment the relevance and effectiveness of current institutional tasks and practises in light of common goals of sustainable minerals sector development.

Include considerations for institutional changes, e.g. the introduction of a geological survey function.

9.7. Priority actions and initiatives

Recommendations for priority actions and initiatives are provided below. Some of these will be to varying degrees be addressed in the EITI process. Thus, one overall and strong recommendation is that the ongoing work towards implementing EITI and achieving candidate status is continued. Consequently, the priority actions and initiatives below are classified as being addressed (wholly or in part) through the EITI, whereas the remainder are classified as being urgent, and in need to be initiated immediately. These urgent actions concern areas where there is a high risk to human health and wellbeing, related to accidents or emergencies, but also concern the need to coordinate existing efforts and projects that support the development Armenian mining sector. The remainder are actions are seen to be needed in either the medium (initiated within 24 months), or in the longer term (> 24 months).

Issues that shall be addressed (whole or in part) by the EITI:

Increase awareness among the public at large	EITI requirement 1 (oversight by the multi stakeholder group) – will contribute to building a better understanding and awareness of the sector among the public at large. EITI requirement 7 will further ensure that impact and importance of the sector is discussed in a wider public debate.
Publish license data	EITI requirement 2 includes the public listing of data and associated information on existing licenses for mining and exploration. This should be done in a way as to be the beginnings of an online cadastre management system.
Attract responsible investors	EITI requirement 2 includes the description of the legal framework and fiscal regime, and this work will contribute to the compilation of a “road map” for mining investments, and thus may assist in attracting new and responsible investors to the sector.
Collect and make available existing data	EITI requirement 3 includes the disclosure of information related to mining production, exploration and exports. This will contribute to the need to collect and make available existing geological data.

Assess mining companies in terms of economic viability and derived benefit streams

EITI requirements 4, 5 and 6 includes the reconciliation of company payments to government, government revenues, revenue allocations as well as social and economic spending that derive from the sector. This work will shed further light on the economic health of the sector, as well as to what extent it contributes to national welfare.

Urgent issues:

Address security risks at both former and present mining operations

The work includes practical actions such as closing off of old mine sites and waste facilities, as well as development and/or update of emergency plans for areas that are at risk in the case of geotechnical failures of waste and mine related facilities.

Development of guidelines for the construction of mine waste facilities

The authorities and private sector must urgently address the need to establish standards for the safe design and management of waste facilities.

Coordinate donors and initiatives

Ongoing efforts and initiatives by various international organisations to assist the Armenian mining sector development need to be streamlined and coordinated.

Medium term:

Collect and make available existing geological data

Existing geological data, housed at the Republican Geological Fund and elsewhere, should be digitised and made available online. This work must be well coordinated with the ongoing project funded by the US-AID project.

Improve management and ease of distribution of existing environmental monitoring data

Environmental monitoring data are collected but they are neither readily available, nor are they being optimally used. As part of an effort to improve the situation, the development of an environmental (and social) information management system for the mineral sector may also be considered.

Inventory and risk assessment of polluted and/or abandoned sites

Ongoing work funded by OSCE (Yerevan State University) and Pure Earth (AUA) should be continued, expanded and coupled with a government led initiative to produce a list of priority sites for rehabilitation / remediation. The work should include costings and considerations of funding.

Encourage private sector initiatives

The companies operating in the Armenian minerals sector need to be encouraged to form company organisations, such as a Chamber of Mines & Minerals, that can champion/lead efforts to improve business ethics and behaviour. Such an initiative should include special considerations for the needs and capabilities of the SMEs that are involved in the sector.

Development of a computerised mining cadastre system

Once the mineral policy has been set, and the criteria and methods to be used to allocate rights to explore and mine, these workflows and requirements should be made part of a computerised mining cadastre system (CMCS). Such a CMCS may ensure the transparent, fair and efficient allocation of such rights.

Review and update of legislation

The Mineral Policy development can serve as a starting point for a review and further development of the legal framework, where development of secondary legislation is of particular importance.

Longer term:

Attract Responsible Investors	This work could include the development of a Road Map to guide mineral sector investors. The road map would assist would be investors to understand and abide by relevant legislation, application processes, and institutional set ups. Not only will this process end up with a useful product, but the process itself would contribute to a better understanding by all relevant parties of the needs, requirements and challenges experienced by the mineral sector. It is proposed that further work to attract investors could focus on targeting specific, mid-sized, international companies that are seen to have the necessary expertise, and resources to successfully run a project or a mine in Armenia.
Technical training for public servants	Capacity building for mining environmental and social management. This includes both technical and human capacity, and with regards to government at both the federal and marz levels.
Increase awareness among the public at large	The goal will be strengthening public awareness and thereby possible participation in mining sector decision-making. As considerable resources are needed for such work, it is recommended that the efforts are focused in the areas with the best geological potential, and specifically in areas where mining activities are already ongoing. This work could benefit from close cooperation between the authorities and suitable CSOs.

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Vallex Group: <http://vallexgroup.am/en>

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Appendix 1: Methodology for input-output analytical framework

The first Social-Accounting matrix for Armenia was constructed in 2008 by National Statistical Service of Armenia (NSS) to implement tax policy analysis using computable general equilibrium (CGE) models. The cornerstone of the social accounting matrix are the input-output coefficients of the economy's main sectors, which describe the structure of output of any given sector in terms of inputs obtained from other sectors of the economy.

To estimate the social economic contribution of the mining sector an input–output model is constructed from observed data for the year 2012 (the last year for which all the relevant economic data is available). The level of sector disaggregation enables us to test the consequences of changes in output in the mining sector. Despite the fact that real inter-industry flows are units of goods (1 ton of steel from manufacturing to construction or 3 tons of stone flow from mining to manufacturing) all the transactions are represented in monetary terms.

Though conceptually based on 2008 NSS matrix, for current estimation purposes only several input-output coefficients of the old SAM are applied. To retrieve the coefficients additional steps were undertaken, which are described below under supply and demand side groupings.

Supply Side. The first step in the construction of the table is the disaggregation and distribution of data in production account by economic activities. For practical reasons of data availability disaggregation of economic activities according to NACE 1 was applied. All the aggregated information for this task is contained in the production account of SNA of Armenia.

Distribution of various types of taxes by economic activities has been implemented using statistical survey of top 1000 taxpayers of Armenia. Distribution of exports as well as imports by economic activities by special “correspondence table” which has been developed by “AVAG Solutions” LLC. This table maps data from the set of commodity nomenclature at 8-digit level into the NACE1. Despite the fact that mapping contains some degree of approximation, overall, this approximation cannot distort data significantly.

Demand Side. By assumptions overall demand for any activity X can be represented as a sum of intermediate and final demands. Intermediate demand by itself represents sales of the particular sector to all other sectors. Final demands in the model include several distinguished categories represented hereafter.

Final demand of Households

Final demand of Government

Final investment Demand

Total Exports

Distribution of consumption by household was implemented using “Households Integrated Living Conditions Survey anonymized micro data”¹³ which is published by NSS yearly¹⁴. Distribution of government expenditures has been completed using state budget data and publication of NSS.

13 Database available at: <http://armstat.am/en/?nid=271>

14 Some approximations were required here because distribution of consumption by economic activities in mentioned survey does not exactly match economic activities that are applied in national accounts.

Appendix 2: Assessment of tailings dams

1. Artsvanik (Zangezur)
2. Geghanoush (Dundee Precious)
3. Teghut (Vallex)
4. Nahatak (MultiGroup Concern)
5. Nazik (non-operational)

ARTSVANIK TSF (ZCMC CJSC)

Location

Dam toe (approximate) 626094.00 m E, 4341351.00 m N, (UTM Zone 38S)

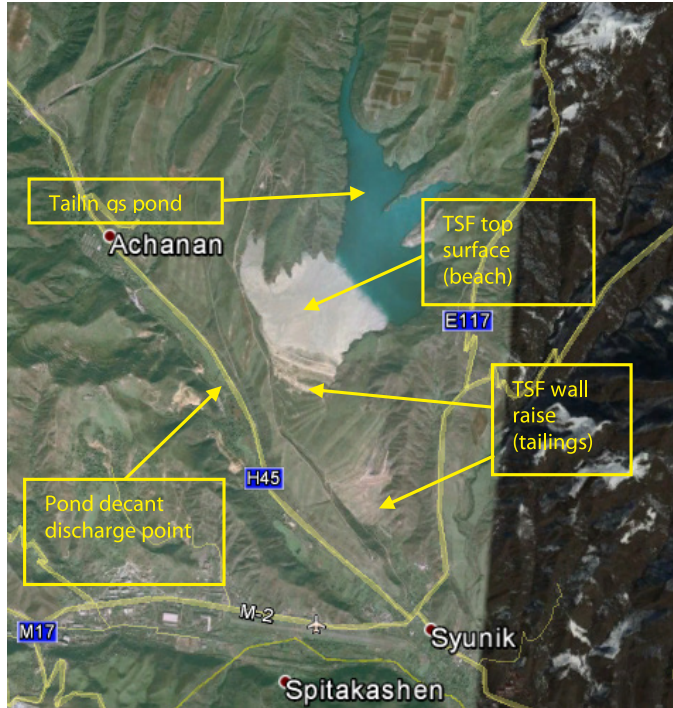


Image source: [Google Earth](#)

ARTSVANIK TSF (ZCMC CJSC)		
Reference photos / plans		
	Downstream wall sectors of TSF	Top surface and pond view from upstream
Spigotting operation (tailings deposition)	Decant tower in tailings pond	

ARTSVANIK TSF (ZCMC CJSC)	
<p>Characteristics and design summary (available information)</p>	<ul style="list-style-type: none"> • No design summary / design documentation made available, although ZCMC did provide a formal interview and site visit • Low potential for ARD tailings. • Process chemicals in tailings transport water. • Downstream rock fill starter dam is present on the lower (southern) slope sector of overall dam but design details unknown. • TSF is raised above starter dam in the lower slope sector using upstream method using tailings fraction forming benched dam raise wall at around 1V:6H, with an overall height of 110m. A plateau separates the lower slope sector from the upper (northern) slope sector and the latter has an average slope of ~1V:20H. The upper slope sector has an overall (benched) slope profile of around 1V:10H and has a total height of approximately 55m. It is understood that the dam will be raised • Current rate of rise of dam is 6m per year, possible increasing to 10m per year as the dam gets higher and topography dictates and smaller surface area for deposition on the future. • The lower (southern) slope sector lies directly above the village of Syunik. • Soil cover has been placed as part of concurrent rehabilitation, but it is very thin. • No basal lining system. • Storage volume and dam life: 310Mm³ for the original design, however, it is understood that the dam is to be raised above the original design level. • Pond water management: A decant tower within the pond area discharges water via a 3.5 x 3.0m tunnel constructed through the in-situ rock on the western abutment. The tunnel (Tunnel 3) discharges directly into the River Okhtar (also referred to as the River Artsvanik). There were previous decant towers and two earlier tunnels – these have become obsolete as the towers are now buried (or almost buried) by tailings. The obsolete Tunnel 2 still has groundwater seepage that enters the tunnel in the dam abutment, and the collected seepage also enters the River Okhtar/Artsvanik directly. • Runoff water management: At present, surface water runoff from upstream valley system and TSF abutment is handled by the decent tower / tunnel system. The current capacity of the decant system (including the runoff potential) is considered to be adequate. It is understood that there are proposals to construct an upstream diversion dam and new tunnel (with discharge to the River Okhtar/Artsvanick) such that runoff does not mix with the tailings pond prior to discharge. • International consultants have been engaged to review dam design. It is understood that a detailed ground investigation and stability assessment will be undertaken to develop stability risk mitigation measures.

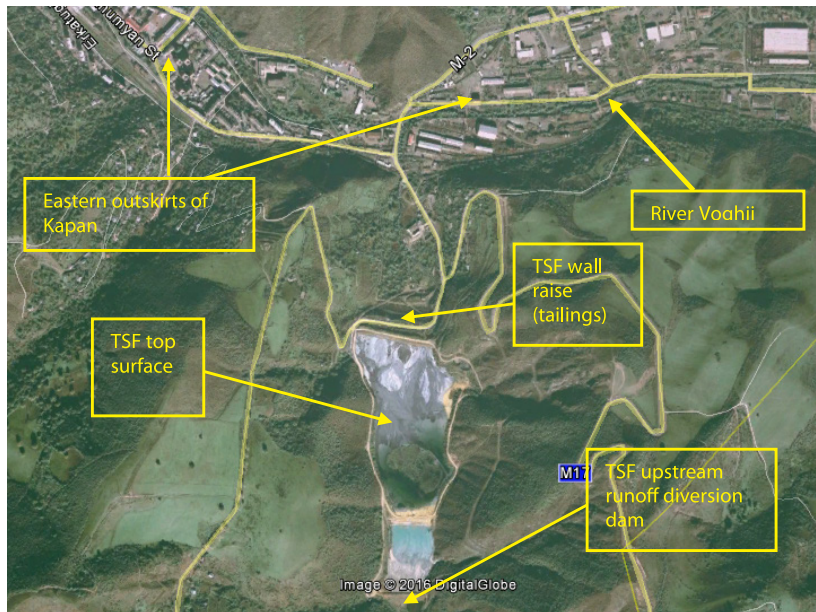
ARTSVANIK TSF (ZCMC CJSC)	
Issues	<ul style="list-style-type: none"> • No detailed design documentation available for review as part of this current project. • The upstream raise method is not advisable for seismically active areas as liquefaction of the tailings during seismic events results in a high probability of instability (catastrophic dam wall failure and flow slide). In mitigation, the upper slope sector has been designed at a very low overall slope inclination and the probability of failure is lower. However, the historic lower slope sector has a higher slope inclination that would have a higher probability of failure during an extreme seismic event, and it lies immediately above the town of Syunik. The results of the review and re-design by the international consultancy engaged by the operator is likely to address these issues. • Decant pond water is discharged directly to the environment. In mitigation, it is understood that there are proposals to create a decant water treatment facility such that the decant water meets German water quality standards for industrial discharges. • The thin layer of restoration material on the outer dam slopes is prone to erosion and exposure tailings with resultant surface water runoff transport into water courses. • There is no clear proposal with regard to the restoration proposals for the upper dam surface at closure. This could be related to the fact that the deposit is regarded as a 'man-made-mine' and presumably could be subject to reworking in the future. While the costs associated with top surface restoration might not be considered justifiable in such a case, it results in a potential gap for exposure to dusting issues between the period defined by initial closure and reworking.

ARTSVANIK TSF (ZCMC CJSC)	
Overall summary	<ul style="list-style-type: none">• The current TSF design would be considered unacceptable in terms of its robustness with respect to physical instability compared with international standards (upstream raise in a seismic area). However, the slopes of the dam are not as steep as with other examples within Armenia and the probability of failure is lower. Notwithstanding this, the lower slope section (at 1V:6H) that lies immediately above the village of Syunik and warrants a detailed risk assessment plus implementation of risk mitigation measures. The upper slope section, at ~1V:10H has a lower probability of failure, but still requires a detailed risk assessment to ensure that the risk levels are acceptable.• The pond water management measures within the design are adequate with respect to the probability of overtopping, provided that the decant system functions as designed.• The probability of ARD generation is considered to be low and no specific measures with respect to long term seepage control / treatment are likely to be needed.• The operator has indicated that studies and associated mitigation measures in relation to i) stability risks and ii) pond water discharge quality are to be implemented.• The downstream restoration cover is inadequate in relation to generally-accepted standards. This is a relatively minor consideration when compared to other issues.

GEGHANUSH TSF (DUNDEE PRECIOUS METALS)

Location

- Dam toe (approximate) 623005.00 m E, 4339343.00 m N, (UTM Zone 38T)

Image source: [Google Earth](#)

GEGHANUSH TSF (DUNDEE PRECIOUS METALS)

Reference photos



Downstream slope - toe



Downstream slope and crest



Crest and tailings beach



Top surface (beach) and pond



Downstream seepage collector pond area and industrial installation (unoccupied)



Downstream industrial installations, banks of River Voghji

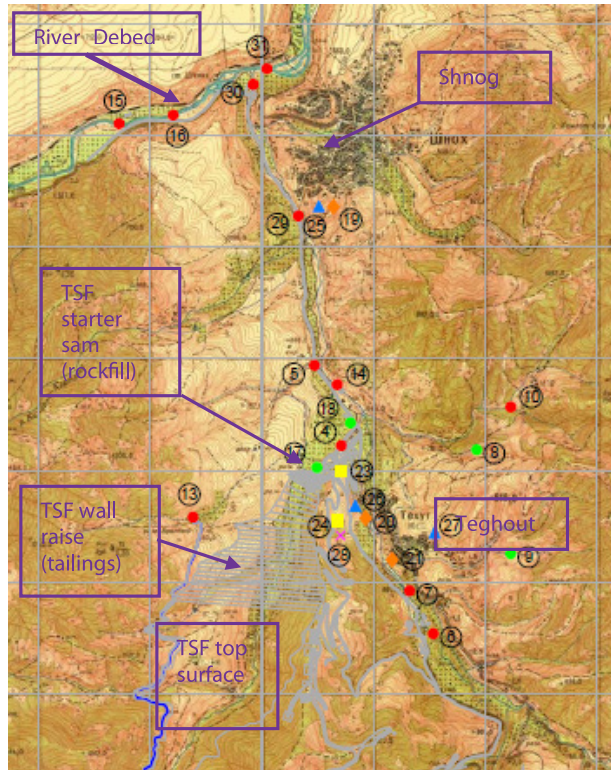
GEGHANUSH TSF (DUNDEE PRECIOUS METALS)	
<p>Characteristics and design summary (available information)</p>	<ul style="list-style-type: none"> • No design summary / design documentation made available. • Formal visit and interview with Dundee Precious Metals not undertaken, but former employee provided information on dam characteristics. • Low potential for ARD tailings. • Process chemicals in tailings transport water. • Downstream rock fill starter dam is present but design details unknown. • The upstream limit of the overall TSF is formed by an earth fill dam structure. This effectively represents a surface water holding structure for surface water (clean) runoff that flows down the Geghanush Valley upstream of the TSF. The runoff water is subsequently diverted via a tunnel located in the eastern abutment of the TSF storage basin. • TSF is raised above starter dam using upstream method with small berms of earth fill forming dam raise wall at around 1V:3.5H (estimated). Series of slopes and benches. • The earth fill bunds used to form the raise in effect provide a soil cover as part of concurrent rehabilitation. • No basal lining system. • Current overall height estimated to be 32 – 35m. • Storage volume and dam life: unknown. • Pond water management: Decant and side-hill culvert on the western abutment direct pond water to toe area polishing pond. • Runoff water management: Upstream diversion dam and tunnel. Side slope channels to collect runoff from the side slopes above the tailings storage area. The tailings beaches are relatively steep and the earth fill bunds used for dam raising result in an adequate freeboard – hence it is unlikely that overtopping can occur (provided that good pond water management is applied in the case of adverse conditions, such as the blockage of the decant system). • Seepage water from the TSF is collected at a polishing / holding pond just beyond the downstream toe. This pond overtopped and the walls were destroyed in 2011. Now re-built. • International consultants have been engaged to review dam design. Seepage control measures have recently been installed within the dam wall (sand drains) in order to manage the groundwater levels within the wall. • There are proposals (advice and design by international consultants) to construct a new dam wall of rock fill downstream of the current dam wall in order to increase the stability of the overall downstream slope. This will apparently change the fundamental TSF design from an upstream raise to a centre-line raise. It will also provide more storage volume. Locals are sceptical about the proposals, viewing them simply as a means of increasing the dam storage capacity, and are apparently not taking into account the benefits of increased stability.

GEGHANUSH TSF (DUNDEE PRECIOUS METALS)	
Issues	<ul style="list-style-type: none"> • No design documentation available for review. • The operating company did not respond to requests for a formal site visit. • The upstream raise method requires seepage to exit via the permeable toe structure (starter dam) to ensure that the tailings wall can drain efficiently. If this does not occur, high groundwater levels within the dam wall can lead to instability. However, this issue has been partly mitigated already by the provision of additional seepage control measures within the dam wall (sand drains). Furthermore, the issue of seepage and groundwater levels within the dam structure will be addressed comprehensively by the construction of the proposed rock fill toe abutment dam. • The upstream raise method is not advisable for seismically active areas as liquefaction of the tailings during seismic events results in a high probability of instability (catastrophic dam wall failure and flow slide). Again, this issue will be addressed comprehensively by the construction of the proposed rock fill toe abutment dam.
Overall summary	<ul style="list-style-type: none"> • According to the former Dundee employee, the tailings have a very low or negligible potential produce ARD. • The current TSF design would be considered unacceptable in terms of its robustness with respect to physical instability compared with international standards (upstream raise in a seismic area). However, the provision of the proposed rock fill to buttress dam should address this.

TEGHOUT TSF (VALLEX)

Location

- Dam toe (approximate) 486341.00 m E, 4551996.00 m N, (UTM Zone 38T)



Source: http://teghout-old.vallexgroup.am/images/docs/Plan_Monitoring_Final.pdf

Characteristics and design summary (available information)

- Potential ARD tailings.
- Process chemicals in tailings transport water.
- Rock fill starter dam ~20m high at downstream toe.
- Raised above starter dam using upstream method with coarse fraction of tailings forming dam raise wall at around 1V:4.5H.
- Concurrent rehabilitation (soil cover) of tailings wall as it is raised.
- Basal clay lining system.
- Proposed final height of tailings wall above crest of rock fill starter dam: 240m.
- Storage volume: 120Mm³ over a design life of 25 years.
- Pond water management via decant towers and buried decant culvert.
- Diversion channels for run-off from upstream catchment area so that the run-off does not enter the tailings pond area.

TEGHOUT TSF (VALLEX)

Issues

- The upstream raise method requires seepage to exit via rock fill toe structure to ensure that the tailings wall can drain efficiently. If this does not occur, high groundwater levels within the dam wall can lead to instability. However, this efficient drainage required for dam stability implies that potential ARD seepage will always need to exit via the rock fill toe, hence there will be a long term issue regarding collection and treatment of ARD.
- The upstream raise method is not advisable for seismically active areas as liquefaction of the tailings during seismic events results in a high probability of instability (catastrophic dam wall failure and flow slide).
- The Rate of Rise (RoR) for the structure varies during the dam life, but is considered to be extremely high (based upon available information) and is well beyond the maximum recommended RoR for upstream raises. The internationally accepted maximum RoR is ~3m per year (this can be higher in arid areas). The RoR for this structure appears to vary between 42m per year initially and 4.3m per year at the end of the life of the dam. The high RoR can result in *static* liquefaction of the tailings (as distinct from the *dynamic* liquefaction of tailings due to seismic shaking).
- The upstream raise slope is 1V:4.5H which would be fine for a TSF in a non-seismic area *and* with a reasonable RoR (<3m per year). However, in this case, there is the potential for seismic activity *and* the RoR is extreme, hence the probability for instability of the dam wall is high.
- The TSF is located in a steeply incised valley (at least during the early years). This places reliance on the ability of the structure to seep through the sidewalls (as well as the rock fill toe structure) to avoid instability issues for the tailings raise wall that abuts onto the steep valley sides.
- The change between the concept of the lined 'base' of the TSF and the 'side slopes' is unclear. The steep valley side slopes will not be conducive to the placement of a clay liner (it is difficult to place liners on slopes steeper than 1V:2.5H). Hence, seepage will occur through the upper (unlined) valley walls. This seepage could be acidic in the medium to long term and its control is difficult as it can disperse into the natural groundwater system prior to capture and treatment via specifically-designed mitigation measures.
- If the side slopes of the valley were to be lined, this would restrict seepage from the tailings mass, and all seepage would be required to exit via the rock fill toe structure. This is located in the narrow mouth of the valley and its capacity to draw down the groundwater within the tailings (if the whole tailings basin is lined) might not be sufficient. This illustrates, for an upstream dam design, the conflict between the goals of i) maximising seepage to ensure efficient drainage of the tailings mass and ii) minimising / controlling seepage to ensure protection of the environment.
- There is no comprehensive groundwater risk assessment associated with the design. The provision of a basal clay liner appears to have been incorporated simply as a generic mitigation measure that can be seen to address contaminated seepage issues for the purposes of regulatory approval. There is not sufficient detail within the design nor in the environmental impact assessment that can demonstrate the effectiveness of the lining system.
- There has been no risk assessment with regards to dam failure (whether this occurs from seismic activity, excessive rate of rise or poor pond water control that initiates overtopping and subsequent dam failure). There is no flow slide assessment or pond water inundation assessment. Potential environmental impacts could be broadly estimated, but the population at risk (PAR) and potential for loss of life (LoL) should have been addressed, particularly in relation to the town of Shnogh which lies in the downstream zone of a failure scenario.

TEGHOUT TSF (VALLEX)	
Overall summary	<ul style="list-style-type: none">• The TSF design is inadequate, both in environmental and physical stability terms.• The TSF has the potential to result in medium to long term environmental impacts due to the presence of ARD-producing materials. There has been insufficient consideration of this aspect particularly for post closure (long term) conditions.• The TSF design would be considered unacceptable in terms of its robustness with respect to physical instability compared with international standards. It is considered that there is a high probability of some form of physical instability issue in the future.• It is understood that Vallex has recognised the need to review the design of the TSF and has engaged international consultants to undertake this review.

NAHATAK TSF (MULTIGROUP)

Location

- Dam toe (approximate) 485350.00 m E, 4557569.00 m N, (UTM Zone 38T)

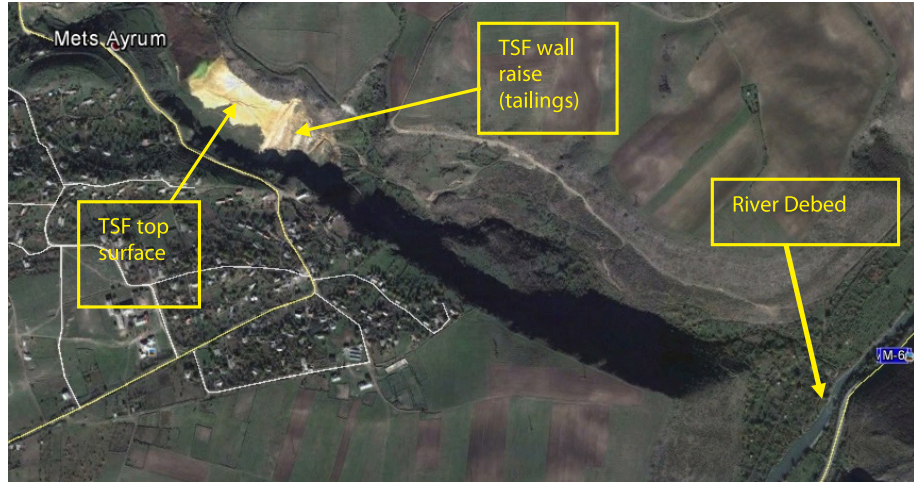


Image source: [Google Earth](#)

Reference photos



Downstream slope



Downstream slope



Top surface – view to crest



Top surface – start of pond






Top surface – pond at rear



Runoff collector pond at upstream end of dam

NAHATAK TSF (MULTIGROUP)	
Characteristics and design summary (available information)	<ul style="list-style-type: none"> • No design summary / design documentation available. • Potential ARD tailings. • Process chemicals in tailings transport water. • Starter dam details unknown. • Raised above starter dam using upstream method with coarse fraction of tailings forming dam raise wall at around 1V:5H (estimated). Series of slopes and benches. • Very limited rehabilitation (soil cover) of tailings wall at the extreme toe, other areas upslope do not have any rehabilitation. • Presence of any basal lining system unknown. • Current overall height estimated to be 25 – 30m. • Storage volume and dam life: unknown. • Pond water management: appears to be via a decant tower at the rear (up-valley) end of the TSF. Not clear if water exits via a buried decant culvert or if it is pumped from the tower. • Upstream earth fill dam holds a pond of runoff water. It is unclear if water is directed via a surface channel around the perimeter or if this pond water is discharged beneath the tailings deposit via a culvert.
Issues	<ul style="list-style-type: none"> • No design documentation available for review. • The operating company did not respond to requests for a formal site visit. • The upstream raise method requires seepage to exit via a permeable toe structure (starter dam) to ensure that the tailings wall can drain efficiently. If this does not occur, high groundwater levels within the dam wall can lead to instability. However, this efficient drainage required for dam stability implies that potential ARD seepage will always need to exit via the toe, hence there will be a long term issue regarding collection and treatment of ARD. • It appears that ARD is already forming on the lower exposed slopes of the tailings raise. • Runoff erosion appears to be occurring down the dam abutments (where the downstream slope abuts the natural ground. However, it is also possible that the erosion is being caused by seepage from the natural ground via fissures within the bedrock – this is a more serious issue as it implies a high groundwater level within the dam wall that implies a lower level of stability when compared to a well-drained structure. • The upstream raise method is not advisable for seismically active areas as liquefaction of the tailings during seismic events results in a high probability of instability (catastrophic dam wall failure and flow slide). • The TSF is located in a steeply incised valley (at least during the early years). This places reliance on the ability of the structure to seep through the side-walls (as well as the rock fill toe structure) to avoid instability issues for the tailings raise wall that abuts onto the steep valley sides. • There appears to be little freeboard, hence the correct management of pond water is critical if overtopping is to be avoided.

NAHATAK TSF (MULTIGROUP)	
Overall summary	<ul style="list-style-type: none">• The TSF design is inadequate, both in environmental and physical stability terms.• The TSF has the potential to result in medium to long term environmental impacts due to the presence of ARD-producing materials.• The TSF design would be considered unacceptable in terms of its robustness with respect to physical instability compared with international standards. It is considered that there is a high probability of some form of physical instability issue under severe seismic loading or poor tailings pond water management.

<h2>NAZIK TSF</h2>	
<p>Location</p>	<ul style="list-style-type: none"> • Dam toe (approximate) 480350.00 m E, 4555336.00 m N, (UTM Zone 38T)  <p>Image source: Google Earth</p>
<p>Reference photos / plans</p>	<div style="display: flex; justify-content: space-around;"> <div data-bbox="429 1197 833 1499">  <p>Downstream wall (lower sector)</p> </div> <div data-bbox="919 1197 1323 1499">  <p>Downstream wall (upper sector)</p> </div> </div>

NAZIK TSF	
<p>Characteristics and design summary (available information)</p>	<ul style="list-style-type: none"> • No design summary / design documentation available, no formal interview or meetings held with dam operator. • The Google Earth location photograph presented above is from available imagery that is out of date. The dam is no longer operational and the top surface and downstream slopes have been covered with soils as part of a restoration effort. • The dam was constructed using the upstream method, with the walls being formed of coarse tailings. • There are two distinct downstream slope sectors (upper and lower). The lower is estimated as being 8 to 10m high at ~1V:3H and the upper is estimated as being 12 to 15m high, also at ~1V:3H. However, no topographical information is available. • There is no tailings pond, but no final spillway or runoff channels for general surface water control from runoff from the upstream valley area are apparent. Therefore, runoff has resulted in the formation of erosion gullies within the restoration soils, exposing tailings. • There is some evidence of ARD (oxidation of exposed tailings). The hazard level / magnitude associated with ARD for the dam structure is not known. Other smaller tailings that have been deposited within the flanks of the River Shamlugh further upstream of the toe of this TSF exhibit evidence of ARD.
<p>Data gaps</p>	<ul style="list-style-type: none"> • No detailed design documentation available for review as part of this current project. • No topographical data for the TSF nor the upstream catchment area is available. • The ARD potential for the tailings is unknown as there is no information available from relevant testing. • The groundwater level within the TSF is unknown. • The geotechnical characteristics of the tailings are unknown. • The geotechnical characteristics of the dam foundations are unknown.

NAZIK TSF	
Hazard identification	<ul style="list-style-type: none"> • Potential ARD production. This would impact groundwater quality and this could manifest as contaminated seepage into the adjacent River Shamlugh. Surface runoff from exposed tailings could result in ARD contamination of runoff. The assumption at this stage (for the purposes of illustrating the mitigation costs) is that the hazard level (probability and magnitude) is sufficient to warrant mitigation. It could transpire that the rate of release of ARD does not justify any mitigation measures at all. As part of a more detailed preliminary assessment, the ARD levels within the River Shamlugh from upstream sources needs to be assessed. Such a study could identify other tailings deposits that should be either i) included as part of a more holistic mitigation plan or ii) prioritised ahead of mitigation for the Nazik TSF. • Dusting. Low assessed hazard level given the presence of restoration cover, even though this is of low quality. Future surface water runoff erosion could increase the hazard level as more tailings are exposed in the unmitigated state (i.e. current poor quality cover). • Dam wall instability. The downstream dam wall sectors are relatively steep and are seen as being susceptible to liquefaction during seismic events. However, the probability of this occurring cannot be quantified since the groundwater / pore water pressure conditions within TSF and the other geotechnical conditions are unknown. The environmental hazard level associated with the primary mechanism of dam failure is assessed as being medium. The societal hazard level (potential for loss of life) associated with the primary mechanism of dam failure is assessed as being low since there are no human receptors in the likely flow path (depth / distance) of a tailings slide. However, there is a secondary hazard identified in that a slump of the dam wall into the relatively narrow valley of the River Shamlugh at the immediate dam toe could block flows within the river, thereby backing up the flow and the formation of a pond upstream of the blockage. This slumped material, being unstable, could then fail and there would be the potential for a flow slide / water release event that has the potential to impact low-lying dwellings in the downstream area. This scenario has a low probability of occurring, but must nonetheless be considered. • Overtopping. There is no permanent pond on the top surface of the TSF, but it is located in a valley. Runoff during extreme rainfall events could result in severe erosion of the downstream face, but it is not envisaged that there would be an associated general dam wall failure given the non-operational status of the structure. Overtopping hazard is therefore assessed as being of a negligible to low level.

NAZIK TSF	
<p>Envisaged mitigation measures</p>	<ul style="list-style-type: none"> • ARD hazard mitigation (medium to long term). Primarily via the placement of a low permeability geosynthetic clay liner (GCL) on the top surface and downstream slopes of the TSF. The assumptions made at this stage are that i) the reduction of infiltration rates into the TSF will reduce production rates of ARD in the medium to long term to satisfactory levels and ii) the groundwater level within the TSF will deplete to a level below the base of the TSF in the medium term owing to the lower infiltration rates. • ARD mitigation (short term). The placement of the GCL surface liner will reduce infiltration rates once it is placed. However, there will be a time delay in the reduction of seepage rates from the TSF that arise from current infiltration to the steady-state condition with the low permeability cover. It is therefore assumed that a passive limestone-filled ARD treatment trench at the overall tone of the TSF will be required in the short term to mitigate ARD seepage during the groundwater drawdown period. It should be noted that there might not be <i>complete</i> drawdown of the groundwater levels within the TSF since natural groundwater seepage into the tailings could still occur via the in-situ ground forming the tailings storage basin (depends upon in-situ groundwater levels). For the purposes of this mitigation costing exercise, it is assumed that the groundwater levels in the surrounding in-situ ground are <i>below</i> the minimum tailings storage level i.e. a simple cover on top of the tailings will control infiltration and ARD production rates and there will eventually be complete drawdown of groundwater within the TSF. • Dusting mitigation. This would be addressed as part of the ARD mitigation (low permeability top cover) since the GCL will need a protective soil cover. In addition to GCL protection, this soil cover would act as a restoration layer that would support vegetation which would control surface erosion. • Dam wall instability hazard mitigation. There is no available space at the toe of the dam to provide for physical buttressing to strengthen / stabilise the slope (unless a culvert were built within the River Shamlugh and fill were placed above the culvert to gain space for the buttress across the river valley). An alternative is to install stone columns within the existing dam slope to provide additional strength within the toe zone of the potential slip surface. However, it has been assumed above that the groundwater levels within the dam after provision of the low permeability cover will eventually reduce to such an extent that there will be no saturated tailings and therefore the probability of liquefaction during a seismic event would be negligible. Furthermore, the loss of life risk is assessed to be low for the primary instability event and the loss of life risk for the secondary event is also low given the low probability of the river blockage scenario described above. Notwithstanding this, there would clearly be environmental impacts associated with the primary instability event, although these would be of limited magnitude and duration. Taking into account the foregoing considerations, a preliminary cost-benefit assessment suggests that the do-nothing scenario would represent an appropriate approach. Notwithstanding this, it has been decided to include the mitigation measure of dam wall strengthening via stone columns simply to illustrate the potential costs involved. • Overtopping. There are no identified significant risks associated with overtopping and the mitigation measures are limited to ensuring that the GCL / restoration cover is sustainable. The provision of a simple runoff channel system is required.

NAZIK TSF**Cost estimate**

- The cost estimates for the various stages of the proposed mitigation plan are summarised below.

Stage	Estimated cost, US\$	Comments
Preliminary investigation	11194	Use local consultants/scientists as far as possible. There is a requirement for the involvement of international experts.
Detailed site investigation	44048	Includes drilling, sampling, installation of sampling wells / piezometers, laboratory testing (geotechnical and environmental), supervision costs, factual report.
Risk assessments and mitigation design	36413	Use local consultants/scientists as far as possible. There is a requirement for the involvement of international experts.
Contract documents	6975	Use local consultants/scientists as far as possible. There is a requirement for the involvement of international experts.
Mitigation works (contractors)	475805	Main works: GCL cover, restoration soils/topsoil cover, runoff control channels, anoxic limestone drain, stone columns.
Mitigation works (CQA / supervision)	19094	Use of local engineers.
Monitoring, review, maintenance	122000	20 years, with reducing requirements over time. Discount rate of 3% applied.
Overall Total	715527	

- As noted previously, it cannot be concluded at this stage that the ARD and stability risks are high enough to warrant all of the proposed mitigation works. If the GCL, ALD and stone columns are not required, the total costs would reduce by around US\$ 260,000 for the contracting costs alone. It is possible that the ARD mitigation measures could be eliminated at the preliminary investigation stage (following initial water quality sampling), further reducing the overall costs associated with ARD risk assessments.

Appendix 3. Costed measures for rehabilitation and closure of TSF

The first table below describes different typical mitigation measures that are commonly applied, as needed, in the rehabilitation of tailings dams, and in particular in the final closure of tailings dams.

Text and tables further below provides typical costs for mitigation measures, based on the consultant's experience, and divided into: (i) capital costs; (ii) maintenance costs, and; (iii) costs for investigation, design, construction supervision and monitoring.

Typical mitigation measures for abandoned TSFs

Issue	Mitigation	Comments
ARD	Low permeability cover	<p>Used to limit infiltration from rainfall hence reduce the production rate of ARD. Achieved by placing one (or a combination of) i) compacted clayey soils, ii) low permeability geomembrane iii) geosynthetic clay liner.</p> <p>Compacted clay cover: Sometimes difficult to locate a suitable source of material within a reasonable distance from the site. Minimum thickness normally 0.5m. Requires Construction Quality Assurance (CQA) for placement. Can desiccate in dry weather periods leading to the opening up of cracks which will compromise its performance unless adequate topsoil cover is placed on top. Performance can be affected by root penetration of restoration vegetation.</p> <p>Low permeability geomembrane: Requires good surface preparation prior to placement, although preparation of tailings generally does not present a major issue. Requires strict CQA to ensure that damage does not occur during installation. Topsoil and restoration soils are placed on top of the geomembrane and this often requires the placement of a geotextile on top of the membrane to protect it from sharp stones / particles within the overlying soils. Restricts root depth development of plants used for restoration. Placement on slopes requires careful consideration of the stability of any restoration soils that are placed on top of the geomembrane.</p> <p>Geosynthetic clay liner: GCL is a commercially-produced low permeability liner formed of a thin layer (up to 5mm) of clay material (bentonite) sandwiched between 2 layers of geotextile. Easy to place, requires minimal surface preparation and CQA. Performance can be affected by root penetration of restoration vegetation. Placement on slopes requires careful consideration of the stability of any restoration soils that are placed on top of the GCL.</p>
ARD	Store / re-release cover	<p>Infiltration is controlled by a suitable thickness and particle grading of a restoration soil cover. The theory is that rainfall infiltration that does occur is stored within the soil cover and then subsequently evaporated during dry periods. Normally requires a more substantial thickness of soil cover to act as storage medium. Not efficient for wet climates. Can result in salts rising up from the underlying tailings and presenting as efflorescence at the surface.</p>

ARD	Capture / interception of ARD	<p>ARD can be captured at identified surface seepage points and / or can be intercepted within the ground at likely sub-surface seepage routes using capture trenches or contaminated groundwater extraction wells. Groundwater seepage can also be intercepted by low permeability cut-off barriers that limit the movement of the contamination away from the perimeter of the facility. In this case, contaminated seepage is manifested at the surface or near-surface and is more readily captured. Once captured or intercepted, the ARD must be directed to a treatment facility.</p> <p>Surface seepage collection: Normally requires some form of low permeability surface trench / pit to effectively capture the seepage. From the final collection point, seepage can be pumped or drained via gravity in pipework to the treatment facility.</p> <p>Groundwater capture (near-surface): Continuous, relatively shallow interceptor trenches can be dug around the toe perimeter of ARD-producing TSFs to a central sump from where ARD is pumped to the treatment facility. The base and downstream side of the trench is normally lined to prevent seepage from simply passing through into the adjacent ground. The capture of near-surface seepage does not address deeper groundwater contamination but can be justified if modelling indicates that the larger part of the ARD issue can be addressed via this measure.</p> <p>Groundwater capture (intermediate depth): This can be achieved by deeper interceptor trenches that are backfilled with granular material and normally incorporate perforated pipework to direct captured seepage efficiently to a central sump for subsequent pumping to the treatment facility.</p> <p>Cut-off barriers: Limits horizontal groundwater seepage below the toe of the facility, but does not completely prevent it. Depth of cut-off curtain needs to be determined from hydrogeological modelling. Generally formed by filling a trench (up to ~5m deep) with low permeability material such as compacted clay backfill or bentonite slurry wall (the latter requires simultaneous trench formation and cut-off wall formation using specialised equipment). Relatively easy for trenches formed in soils, trenches constructed in rock very expensive. For cut-off barriers that need to be deeper, formation of a low permeability curtain can be undertaken by injection of bentonite via rows of boreholes (within soils and / or rock). Wells often need to be closely spaced to form a continuous curtain.</p> <p>Extraction wells: A series of wells is drilled around the perimeter of the facility. Normally each well requires a small pump or syphon that directs captured seepage to a central collection point. Wells often need to be closely spaced. Requires drilling rig. If pumps are installed there is a need for an electricity supply. Overall system prone to breakdowns, theft and vandalism.</p>
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ARD	Treatment	<p>Treatment of ARD can be achieved by provision of passive anoxic limestone drains. These can be limestone-gravel-filled trenches constructed around the perimeter of a facility through which ARD seepage passes and is treated prior to seepage reaching the external environment). Alternatively, captured / intercepted seepage can be directed to centrally-located anoxic limestone drain that does not necessarily have to be formed around the toe perimeter of the facility. Other measures for captured / intercepted ARD can be achieved actively via lime addition or passively via wetlands (or a combination of the two) or via more sophisticated treatment plants. The latter is not normally cost effective and is only undertaken where it can be justified in cases of very high risk cases.</p> <p>Anoxic limestone drains: Can be formed in a similar manner to cut-off barriers within trenches around the toe of the facility, but the concept differs in that the trench is designed to allow flow through it (with passive treatment of ARD taking place). Where a centrally-located anoxic limestone drain is adopted (easier maintenance, lower volume of limestone generally required), it must be ensured that ARD seepage from the toe perimeter of the facility is effectively captured and directed to the anoxic limestone drain. Needs periodic replacement of limestone once its buffering capacity has been depleted.</p> <p>Lime addition: Requires installation of mixing tanks. The sludge produced (hydroxides) are very low density and must be directed to an appropriate storage facility that would ideally be maintained in a flooded condition (to prevent re-mobilisation of metals) and normally needs to be lined. Over the long term, the storage volume requirements can be very high. It must be ensured that ARD seepage from the toe perimeter of the facility is effectively captured and directed to the treatment area.</p> <p>Wetlands: Used where the level of contamination is not too high. Can require high surface areas for efficient treatment and sizes are contaminant-concentration and flow-rate dependent. Require refurbishment after 10 – 20 years of operation. Organic materials (plants / sludge) need to be disposed of adequately as a result of the refurbishment process.</p>
Dusting	Soil or granular covers	Requires a source of cover material. Soil covers must be adequately vegetated to prevent erosion. Granular covers are less critical in terms of this, but have limited potential for the establishment of a vegetative cover.
Dam wall instability	Buttressing	Adopted where the post closure stability of a TSF is deemed to represent a hazard. Large volumes of fill are normally required.
Dam wall instability	Stone columns	If there is no space for buttressing at the toe of a TSF, the wall itself can be strengthened by installing large diameter stone columns (similar to civil engineering construction piles) at close spacing along the toe of the dam wall. The concept is to strengthen the wall in the critical toe zone through which a slip surface would pass, not over the entire slope.
Dam wall instability	Control of groundwater levels within / behind the dam wall	Achieved by reducing the groundwater level (phreatic surface / pore water pressures) within and/or behind the dam wall. Can be as simple as forming a toe trench or providing a small buttress of granular material at the toe of the dam wall (<i>passive</i> measures). In more serious cases, <i>active</i> groundwater extraction wells can be installed up the dam slope to intercept and reduce the pore water pressures. If the seepage is ARD contaminated, treatment of the collected water will be required.
Overtopping	Provision of final spillways and / or diversion channels	Final spillways are readily constructed. However, there is often the need to connect the final pond area (lower elevation) through to the spillway at the dam crest (higher elevation), hence a connector channel is often required. This channel can be relatively deep at the spillway / crest location since it has to be excavated through the tailings beach which rises towards the dam crest from the former (operating) pond area.

Mitigation measures – capital costs

The mitigation measures listed within the following cost estimate table is not definitive. The purpose is to provide broad estimates for the *primary* components of the mitigation measures listed. There will be *secondary* or *enabling* works that are required to support the primary works that are difficult to cost due to site-specific conditions. Examples include re-profiling or re-grading of existing TSF topography to achieve runoff control and construction of access routes. Furthermore, general contracting costs such as mobilisation, insurances, method-related charges, surveying, provision of offices will depend upon the size of the contract and are not included within the estimates. It should be noted that unit rates for works tend to reduce for larger projects.

It is very difficult to provide reasonable generic cost estimates since there are generally great variations in site specific conditions, such as overall topography (catchment area and TSF), ARD flow rates, ARD geochemistry and other site specific characteristics. It is more reasonable to estimate costs for each TSF site on a stand-alone basis once a preliminary investigation and desk study has been carried out.

Mitigation Measure	Target Issue	Unit	Rate	Relative overall mitigation capital cost*	Notes
Surface covers / restoration					
1a. Soils	Dusting, surface erosion	Ha	25,000 to 30,000	\$\$	Required for all TSFs unless rock fill surface cover provided. Thickness of cover varies according to proposed planting scheme and risk of upward migration of salts from non-ARD tailings. Cost assumes for 1m thick layer of restoration soil and haulage distance of 1km.
1b. Waste rock	Dusting, surface erosion	Ha	8,000 to 12,000	\$	Needs to be clean, non-ARD waste rock. Rate assumes free source of rock fill. Does not include for geotextile separator that might be required to prevent rock fill sinking into tailings during placement, but it may be required. Cost assumes for 0.5m thick layer of rock fill and haulage distance of 1km.
2a. Low permeability liner: Compacted clay	ARD (ongoing generation)	Ha	50,000 to 65,000	\$\$\$	Needs suitable source. Cost assumes for 1m thick layer of clay and haulage distance of 1km. Requires a layer of restoration soils (see Item 1a in this table) on top of the clay to minimise the potential for desiccation and root penetration. Hence, overall relative cost becomes higher since Item 1a must be added on.
2b. Low permeability liner: Geomembrane	ARD (ongoing generation)	Ha	65,000 to 85,000	\$\$\$\$	Requires a layer of restoration soils (see Item 1a in this table) on top of the geomembrane to protect it and to provide a medium for restoration vegetation. Hence, overall relative cost becomes higher since Item 1a must be added on. Rate allows for a geotextile protector between the relatively thin and delicate geomembrane liner and the overlying restoration soils as this is a normal requirement.

Mitigation Measure	Target Issue	Unit	Rate	Relative overall mitigation capital cost*	Notes
2c. Low permeability liner: GCL	ARD (ongoing generation)	Ha	45,000 to 65,000	\$\$\$	Requires a layer of restoration soils (see Item 1a in this table) on top of the GCL to protect it and to provide a medium for restoration vegetation. Hence, overall relative cost becomes higher since Item 1a must be added on. GCL is more robust than geomembrane hence does not normally require additional protection via an additional geotextile.
3a. Revegetation	Protection against surface runoff erosion	Ha	1,500 to 3,000	\$	For grass seeding, not shrubs / trees. Can only be applied to surfaces restored with soils, not applicable to rock fill cover. Cost variation depends on application rate of fertiliser (depends on soil quality).
3b. Revegetation	Enhanced protection against surface runoff erosion	Ha	1,700 to 2,500	\$	Planting of shrubs / trees for enhancement of restoration with grass seeding. Can generally only be applied to surfaces restored with soils, not generally applicable to rock fill cover. Only a proportion of the upper surface will require enhanced restoration. Current estimate based upon 30% of total surface area. Costs are species dependent.
Contaminated seepage interception and treatment systems					
4a. Anoxic limestone drain	ARD seepage	l/s of seepage	40,000 to 80,000	\$\$ to \$\$\$	Only a very broad indication of costs can be given for each litre per second of ARD seepage. The design of any system requires detailed geochemical modelling. Flow rates, contaminant loads, ambient temperatures and acidity levels are highly variable in each situation. Required residence times of seepage within ALDs also varies significantly according to the geochemistry.
4b. Permeable limestone reactive barrier	ARD seepage	l/s of seepage	30,000 to 50,000	\$\$ to \$\$\$	See comments above for 4a.
5a. Dosing	ARD seepage	Ha	50,000 to 100,000	\$\$ to \$\$\$\$	Cost largely relates to the size of storage facility that is required to store the sludge produced. Also depends on the nature of the lining system used within the pond (if any). Capital cost for mixing tanks etc. can be 7,500 to 15,000.
6a. Wetlands	ARD seepage	Ha	150,000 to 200,000	\$\$\$\$\$	Only a very broad indication of costs can be given for each litre per second of ARD seepage. The design of any system requires detailed geochemical modelling. Flow rates, contaminant loads, ambient temperatures and acidity levels are highly variable in each situation. Required residence times of seepage within wetlands also varies significantly according to the geochemistry. Cost is based upon reed bed system with organic soils and limestone beds.

Mitigation Measure	Target Issue	Unit	Rate	Relative overall mitigation capital cost*	Notes
Surface water runoff control (extreme events)					
7a. Runoff diversion channels	Large scale erosion of dam wall face	Per m of channel	150 to 1,000	\$ to \$\$	Price per linear metre of channel. Lower cost for channels lined with clean rock fill. Higher cost for concrete channels. Higher costs associated with larger catchment areas for dams.
7b. Ancilliary works (energy dissipators, spillways, upstream control)	Large scale erosion of dam wall face	sum	2500 to 25,000	\$	Largely depends on size of catchment area, size of TSF and runoff characteristics.
Dam wall instability					
8a. Buttressing	Instability of dam wall	Per m length of dam wall	Dam height of 30m: 150 to 200 Dam height of 45m: 350 to 420 Dam height of 60m: 600 to 725	\$ to \$\$\$	It is very difficult to estimate rock fill buttressing costs since the size of the buttress for any particular dam can only be determined from detailed stability analyses. As a very rough estimate it can be assumed that the buttress will be 1/3 of the overall dam height and that its crest width will also be equal to 1/3 of the overall dam height. Assumes free rock fill source and maximum 1km haul distance.
8b. Stone columns	Instability of dam wall	Per m length of dam wall	Dam height of 30m: 450 Dam height of 45m: 680 Dam height of 60m: 1500 (requires 2 rows of stone columns)	\$\$ to \$\$\$\$	As with rock fill buttressing, it is very difficult to estimate rock fill buttressing costs since the extent of the strengthening with stone columns for any particular dam can only be determined from detailed stability analyses. As a very rough estimate it can be assumed that the depth of columns will be 1/3 of the overall dam height and that they are drilled every 3m along the toe area of the dam wall that requires strengthening. Assumes free rock fill source and maximum 1km haul distance.

Mitigation measures – maintenance costs

Some mitigation measures do not incur ongoing maintenance costs, or any related costs are so small as to not warrant consideration. This is generally true for soil and low permeability covers, surface water runoff control channels and dam wall stabilisation measures.

Revegetation requires maintenance in the early years but this requirement drops off once the vegetation cover has been established and is self-sustaining.

The highest maintenance costs are associated with ongoing ARD seepage treatment. Hence, it can be seen that a great benefit can be gained by provision of mitigation measures (such as low permeability covers) that are aimed at reducing the production of ARD in the medium to long term.

As with the estimates presented to capital costs above, the cost for ongoing maintenance are only very broad estimates and should be treated as such. It is very difficult to provide reasonable cost estimates without a knowledge of ARD flow rates, geochemistry and other site specific conditions.

Mitigation Measure	Maintenance	Unit	Rate	Notes
3a. Revegetation	Grasslands	Per Ha every 5 years	3,000 to 4,500	Herbicide application, reseeding, cutting, strimming. Cost is a lump sum for a 5 year period. Should only be required in once in first 5 years.
3b. Revegetation	Shrubs trees	Per Ha every 5 years	3,200 to 4,000	Planting of shrubs / trees for enhancement of restoration with grass seeding. Can generally only be applied to surfaces restored with soils, not generally applicable to rock fill cover. Only a proportion of the upper surface will require enhanced restoration. Current estimate based upon 30% of total surface area. Costs are species dependent.
4a. Anoxic limestone drain	Replacement of limestone gravel	Per l/s of seepage every 10 years	25,000 to 50,000	Only a very broad indication of costs can be given – depends upon the performance of the ALD (limestone consumption, armouring (blinding) of gravel.
4b. Permeable limestone reactive barrier	Replacement of limestone gravel	Per l/s of seepage every 10 years	20,000 to 32,000	See comments above for 4a.
5a. Dosing	Replacement sludge storage facility and closure of previous facility	Lump sum: one-off future capital expenditure, once every 10 to 20 years	95 to 120% of original cost.	Cost largely relates to the size of the original storage facility and the rate of sludge produced per year. Timeframe unknown, but the original facility should have been designed for a 10 to 20 year life. Costs can be higher than original facility capital costs since there is a need to close the original facility. However, closure with water cover is the least cost option and is insignificant provided it is a water retaining design in the first place.
6a. Wetlands	Replacement nutrients, plants/ reeds, limestone buffering. Disposal of depleted materials to landfill.	Lump sum: one-off future capital expenditure, once every 10 to 20 years	80 to 100% of original cost.	Lining systems remain in place and do not add to maintenance costs. Costs for disposal of depleted materials difficult to estimate.

Mitigation measures – investigation, design, construction supervision and monitoring costs

All of the following costs are site dependent. More complex sites require more detailed investigations, risk assessments and ongoing monitoring.

Aspect	Cost	Notes
Preliminary investigation	10,000 to 25,000	
Detailed site investigation	10 to 25% of capital costs of mitigation works	Relates to complexity of site and number of issues identified.
Risk analyses and design of mitigation measures	5 to 15% of capital costs of mitigation works	Relates to complexity of site and number of issues identified.

Aspect	Cost	Notes
Contract documentation	2 to 8% of capital costs of mitigation works	Includes detailed design drawings.
Supervision	4 to 12% of capital costs of mitigation works	Relates to time on site and number of engineers required. More complex works take longer to implement and generally require more staff.
Monitoring, review	18 to 28% of capital costs of mitigation works	Includes testing, review, inspection, reporting. Cost is based upon a period of 20 years using a discount rate of 3%.

