CONTENTS

TABLES

FIGURES

APPENDICES

6.18 Community Health, Safety and Security

This analysis combines the results of the health impact assessment (HIA) with an assessment of community safety and security impacts (refer to Section 6.3 for impact assessment methodology).

6.18.1 Methodology

A HIA is intended to identify and estimate the lasting or significant changes of Project activities on the health status of a defined population by adopting a systematic approach to identifying the different health and wellbeing impacts, both positive and negative, of plans and Projects on this population. The HIA followed the methodology outlined in the Good Practice Note on HIA, as supported by the IFC. The methodology addresses health impacts across twelve Environmental Health Areas (EHAs), each of which is addressed in this section, but limited to their respective relevance to the Project. The EHA framework defines the types of health impacts and provides a structure for organizing and analysing potential Project impacts in the community.[1]

6.18.2 Potentially Affected Communities

In order to undertake a HIA it is necessary to define the potentially affected communities (PACs) which are not necessarily the same as the affected communities defined for social or environmental impacts. A PAC is a defined community within a clear geographical boundary where Project-related health impacts may reasonably be expected to occur. PACs are inherently prospective and represent best professional judgements of health impact assessors. To define the PACs, the following considerations were made:

- Is there a hazard?
- Who or what may be exposed to this hazard (pathway and rate of exposure to estimate the concentration/extent to which human receptors of concern may be exposed)?
- The mode: air, water, food, vector, and social determinant etc. and route: inhalation, ingestion etc. of exposure?
- What is the risk of exposure based on a likelihood and consequence analysis (magnitude, duration and length)?
- How sensitive or vulnerable the receptor is to the potential hazard or impact? The

[1] IFC (2009), Introduction to Health Impact Assessment (HIA) – Good Practice Guidance

prevailing health needs in the area underscore these vulnerabilities; and coupled with the institutional capacity to manage potential health impacts, highlights potential sensitivities in the PACs.

Based on these questions, five potential PACs were considered for the Project as described below and illustrated in
Figure **6.18.1**. This includes a brief description of the potential exposure hazards of the respective PACs:

PAC 1: Gorayk and Saravan Communities

Gorayk village is east of Saravan on the M2 highway, approximately 12km south-east of the HLF and 4.7 km to the Tigranes/Artavazdes open pits (see Table 3.1, in Chapter 3 for the distances of each element of the Project to Gorayk and Saravan. This community used to reside 2km further to the east but were resettled in the 1960's to allow for the creation of the Spandaryan Reservoir. This has created numerous challenges, as the new area is prone to flooding and the high water table creates significant challenges with dampness or damp conditions, coupled with the heating in houses the high levels of indoor humidity leads to the growth of mould[2]. Indoor air quality is a known existing challenge with high measured radon levels in the local houses (see Section 6.17.9). While this may pose a future health risk to the community, this is entirely unrelated to the Project and will not be directly influenced by future Project activities.

Saravan is located on the M2 highway, southwest of the Project. Saravan includes the villages of Saralanj and Ughedzor (which is only occupied during summer months). The heap leach facility will be located approximately 2km to the north of Saravan. Livelihood strategies include agriculture and small-scale commerce. The village, as with other rural communities, does not have access to an adequate sanitation system. Until recently, Saravan did not have access to natural gas, but in 2013/2014 an external and internal system was developed by the local government, with support from Lydian.

The impacts from the Project on these two communities are expected to be relatively homogenous. The development of the HLF (Gndevaz) and mining of Erato and

[2] Wardell-Armstrong, Amulsar Open Pit Gold Project Scoping Report. 2011

Tigranes/Artavazdes pits are the most likely direct impacts to these communities, but they are expected to be minimal (3.9 km away at closest point to Saralanj). There may be some limited noise from blasting from the HLF platform construction, open pits and some limited visual impacts, with these more relevant in Gndevaz (full analysis of visual impacts is contained within Section 6.5 and for blasting, in the context of noise and vibration, in Section 6.7).

Reduced air quality due to dust or emissions from the HLF should not influence Gorayk and Saravan but may influence Gndevaz (full analysis of air quality impacts is contained in Section 6.6).

Traffic impacts are discussed in Section 6.18, but are unlikely to impact significantly in these communities as the main road to Iran is not likely to experience increased traffic from direct association with the Project. Most of the traffic generated as a result to the Project will use the H-42 road.

PAC 2: Gndevaz

Gndevaz is located on the national H-42 road, to the south of Jermuk. This community is likely to be most directly impacted by the presence of the Project due to the location of the HLF, ADR plant, overland conveyer, contact process and storm water collection ponds and the temporary construction camp. The two primary access routes to the Project will be from immediately east and 1.3km to the south of Gndevaz. It is expected that traffic will significantly increase along the H-42 passing alongside the village, as a direct result from Project or service vehicles.

Environmental health effects are likely to be most evident in Gndevaz with noise, air quality and water quality all potential impacts. These specialist reports address potential human health impacts related to specific regulatory compliance targets in more detail in Sections 6.7, 6.6, 6.10 respectively.

PAC 3: Jermuk Area

The Jermuk area includes Jermuk town, including the so-called 'east bank' and Kechut. Jermuk is located on the national H-42 road at an altitude of about 2000m on the Arpa River. Jermuk's main economy is driven from its attraction as a local tourist destination with thermal waters and numerous spas, as well as mineral water bottling plants.

This area is located approximately 7km to the north-west of the open pits, 4km from the BRSF and is 6.5km from the HLF. The BRSF is closest to Kechut at 4.1km but the topography of the land makes impacts from ground or surface water quality unlikely. Depending on the size of the camp selected for construction (options range from 550 to 920 beds), a peak of 370 workers may be accommodated in Jermuk hotel accommodation during the construction period. During operations approximately 250 workers will reside in Jermuk, primarily in hotel accommodation.

The Project is located downstream from the Kechut reservoir so any potential water impacts are not likely to affect this area. Noise and vibration from the mine or related activities are not anticipated. Air quality from the mine is not likely to impact on Jermuk, with any air quality and noise concerns related to increased motor vehicle traffic in the town, with an associated increase in emissions (sulphur dioxide and diesel particulate matter). Again, these will be described in separate specialist studies and related stakeholder communication where interested and affected parties have expressed concern on environmental impacts from the Project.

The indirect effects of the Project are likely to be most significant in Jermuk.. The accommodation plans for the Project may alter the social and economic structure of the town and be likely to influence some social determinants of health. However, Lydian is working with and supporting this community as part of its social strategy to enhance the benefits of the Project, as well as to mitigate any indirect impacts. Different health impacts will also be managed as part of this social strategy.

PAC 4: Seasonal Herders

Seasonal herders who graze their livestock in the valleys around the BRSF area may be impacted. Direct impacts may include noise and concerns related to water quality and water accessibility. Changes in the socio-economic structures may also influence these seasonal migrants especially in terms of potential inflation of food and housing. In addition, if herders need to access pastures more removed from roads there may be a reduced ability to transfer their produce (especially milk) to markets with an associated reduced income.

PAC 5: Transport Corridor

The various transport corridors to support the supply chain of the Project is considered a separate PAC, as partially presented on the map in

Figure **6.18.1**.

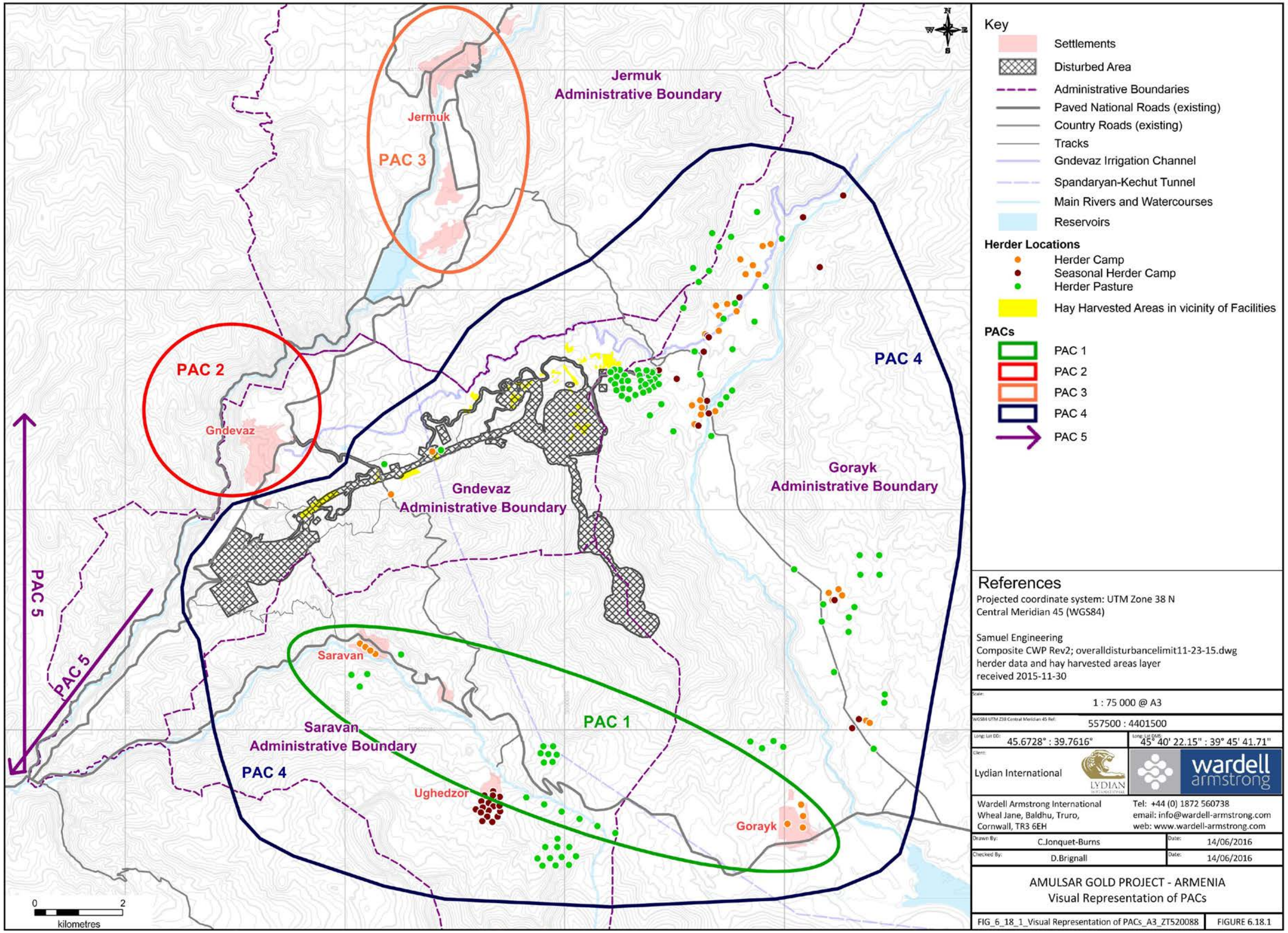

Figure 6.18.1: Visual Representation of PACs

Gender and Vulnerable Groups in Potentially Affected Communities

The social impact assessment discusses specific gender impacts and vulnerable groups in the study area. However, there is merit in mentioning these from a health impact perspective. They include:

- Women:
    - Due to the nature of mining, local women are less likely to benefit from employment on the Project. This includes the unskilled portion of the workforce, as this work is likely to involve manual labour to which men will be more suited. Thus, the direct socio-economic benefits of the Project may not be experienced by local women. Improved socio-economic attainment by women has been associated with better outcomes in maternal and child health and any improvement or deterioration in socio economic conditions can play an important role in these development indicators.
    - Women and young girls may be susceptible to advances from men that are employed on the Project. The poor socio-economic circumstances in the community and lack of opportunity for young girls may lead to the development of transactional sexual relationships that can influence social cohesion, increase risk of sexually transmitted infections and unwanted pregnancies in this group. Local social services are poorly resourced to support young girls.
- Herders and agriculture dependent households:
    - Reduced access to land and proximity of pastures to access roads may limit the ability to generate produce or reduce access to markets to sell produce. This may lead to a loss of income or increase the effort required to generate the same income with potential health impacts on nutrition and quality of life.
- Poor people:
    - The development of the Project has the potential to influence socio-economic conditions in the study area and in the PACs. Inflation on goods and services (housing and food) may occur with an associated significant negative impact on already poor people. Improved access into the area may limit the ability for poor people to sell goods locally but may also increase exposure to markets that were not accessible before the Project started.

- Elderly:
  - The elderly may be more susceptible to social-economic and environmental health changes related to the Project including:
    - Inflation of goods and services and ability to afford them given the inability to work or increase incomes.
    - Influence on sense of place and altered quality of life linked to increased activity associated with mining - even if indirect in the broader study area.
    - Increased susceptibility to health conditions related to potential environmental exposures associated with mining - for example respiratory conditions related to dust exposure (although a minor to negligible significance).
- Children may be more susceptible to health conditions related to potential environmental exposures associated with mining - for example respiratory conditions related to dust exposure (although a minor to negligible significance).

6.18.3 Key Potential Community Health, Safety and Security Impacts

The key potential impacts summarised by relevant EHA include:

- Communicable disease linked to the living environment;
- Vector related disease;
- Water sanitation and waste related disease;
- High risk sexual practices, STIs including HIV/AIDS;
- Food and Nutrition;
- Non-communicable diseases;
- Environmental health determinants;
- Social determinants of health;
- Cultural health practices;
- Health services and systems;
- Injuries and accidents, including road accidents; and
- Security conflicts.

Environmental health issues have been raised by stakeholders as a topic of concern during the ESIA engagement process. To fully address these concerns, additional studies have been conducted on the following topics: radiation, water quality, air quality and noise/vibration, each of which is summarised in this chapter.

6.18.4 Communicable Diseases Linked to the Living Environment

Project Activities Affecting Communicable Disease Transmission Linked to the Living Environment

There are a number of communicable diseases whose local transmission patterns may be directly and indirectly influenced due to changing social and environmental health conditions related to the Project development. Accommodation of workers is a key factor in managing risk related to transmission of communicable diseases. The construction camp will be designed as a closed, dry facility to limit interaction with local communities. However, the regular shuttle bus services from the mine to Jermuk and surrounding settlements will limit the level of separation between workers and the community. The hotel accommodation will be open in nature; however, services will be provided within the hotels to provide self-sufficiency for workers. The hotels will provide accommodation for a peak number of 370 construction workers on a short term basis, and 250 operational workers, who are non-resident in the local area and commute regularly back to their point of origin and families. It is assumed the majority of these workers will be men.

Depending on the success of the local recruitment initiatives, additional non-local employees may also move into the area (predominantly to Jermuk/Kechut or Gndevaz it is assumed). These additional non-local employees (expected to be in the order of 210 workers) are likely to either rent or buy housing in the local area and may well move with their families (see Section 6.12 for greater discussion on this topic).

The most important of these diseases is tuberculosis (TB), which is noted as a significant national public health issue, although trends in both incidence and prevalence rates appear to be improving. The baseline section describes TB in more detail but of relevance in the impact assessment is that most cases that are notified locally are cases that are imported from outside of the immediate study area. This underscores the importance of migration of people related to TB transmission and spread and the relevance of managing accommodation and where people work in close association on the Project. The weak health system and the poor health seeking behaviour of the community are both risk factors that may increase the risk for disease transmission.

Measles is also an important disease risk, with recent outbreaks reported across Europe, especially in people above 20 years of age, reflecting ineffective vaccination campaigns when they were children.

Potential Communicable Disease Impacts Linked to the Living Environment

Prior to mitigation, it is anticipated that impacts related to communicable diseases linked to the environment could be felt in the medium term, be restricted to the study area, and have a moderate negative health effect. It is possible that these health consequences will occur representing an overall **moderate negative health impact significance**. The impacts are anticipated to occur in construction and will persist to a lesser degree in the operational phase due to the reduced size of the workforce.

These potential impacts could affect Gndevaz, Gorayk/Saravan and Jermuk PACs. The elderly, children, and those with impaired immune systems (elderly, malnourished etc.), are likely to be specific vulnerable groups due to their increased susceptibility in acquiring these conditions. There are not likely to be specific gender related impacts.

The Project development has the potential to impact community health linked to communicable diseases in the living environment, in the following direct and indirect manners:

Direct:

- The incoming workforce has the potential to introduce communicable diseases into the study area if they originate from areas where there is a higher incidence of circulating communicable disease. This is especially important for TB with an associated high proportion of MDR-TB cases. Reports that recently diagnosed TB cases in the study area were imported from migrants underscore this risk. This may be exacerbated through the return of family members who have been working in other countries (predominantly Russia).
- Overcrowding in workplace accommodation may promote the spread of communicable diseases, with TB and influenza specific concerns.
- Influenza may be introduced from different areas of the world and this may pose a significant health risk, especially to vulnerable groups in the community. This will be important in construction with the movements of large groups/numbers of people in and out of the area. This is especially relevant for expatriate staff and travellers as they

may introduce novel communicable diseases into the area, potentially even seasonal viruses circulating in other hemispheres. The recent and current risk of pandemic outbreaks of influenza, especially H1N1 and H7N9, are such examples.

Indirect:

- In-migration into the area may occur with migrants (both returning and speculative) seeking direct or indirect employment opportunities from the Project (see Section 6.12 for a more detailed analysis of this impact). The increased population may place pressure on housing in the area. This has the potential to cause overcrowding as the ability to afford the construction of new houses in the PACs is low. Increased opportunities in the area is also likely to reduce the trend of people leaving the rural communities to seek work in other parts of Armenia or Russia, (this practice reduced in the period 2011-12, but re-commenced in 2013-14 when Project development was delayed).
- Influx and use of hotel facilities by workers and migrant businessmen may influence local pricing due to supply and demand. This potential impact is discussed in more detail in Chapter 6.21, with due consideration for associated health impacts related to potential influences on the local economy and the entire tourism supply chain.
- The Project has the potential to improve the local housing in the study area through indirect economic development. The workforce that is hired locally will reside in their host community, and by earning a good wage, will be in a position to improve their living environment. There is also the possibility that the housing in the general community will improve because of economic development.

Mitigation of Communicable Disease Linked to the Living Environment Impacts

These potential impacts will be mitigated through the following activities:

Project Impact Mitigation:

- Adequate accommodation arrangements will be made available to the workforce so that overcrowding does not occur in the temporary construction camp or in Jermuk hotel accommodation to the extent that it is utilised by the Project. The IFC and EBRD guidance note should serve as a reference to support this. Monitoring will also take place to determine the level of in-migration which is occurring;
- Monitor housing inflation in Jermuk and the other PACs, and costs of hotel rooms in Jermuk and bed occupancy in peak tourist seasons;

- Support the development of a community health information system (CHIS) to monitor specific key health indicators on communicable diseases from longitudinal health data sources; and
- Monitor pandemic influenza alerts through the World Health Organisation (WHO) notifications.

Occupational Health, Safety and Environmental Management:

- Workplace pandemic preparedness policies and programmes will be developed and maintained to reduce the impact of any suspected or confirmed outbreak of communicable disease at the local level. These will include effective surveillance mechanisms;
- A workplace TB management policy and programme for the workforce (including contractors and short term labourers) will be developed. This will be integrated into the Project's HIV policy. Programmes will be based on and integrated into national programmes;
- Screening of employees at recruitment for TB and provision of adequate referral and support for on-going treatment programmes from the workplace medical service to the national treatment programmes. This will need to occur prior to final appointment and mobilisation of workers to ensure that diseases are not brought into the area. These screenings must be part of the contractor management framework and a KPI for the Company and contractors to address;
- Develop programmes for vaccine preventable diseases and ensure that all staff receive a booster of diphtheria and pertussis as well as measles, mumps and rubella vaccines;
- Monitor airborne pollutants to ensure that occupational exposure limits are not exceeded for elements such as respirable crystalline silica as development of silicosis has the potential to synergistically increase risk for development of TB. These risks are classified as low based on current knowledge and need to be addressed in the occupational health and safety plan; and
- Consideration will be given to developing seasonal influenza vaccinations to all staff that rotate between the Project and their country of origin.

Residual Communicable Disease Impacts Linked to the Living Environment

Effective and sustained implementation of the mitigation measures described above is anticipated to support a residual a minor negative health impact, in the short term and at a localised level. These impacts are unlikely, providing for an overall **negligible health impact with mitigation.**

6.18.5 Vector Borne Diseases

Project Activities Affecting Vector Borne Diseases

The only Project activity that would be likely to have any effect on vector borne diseases is through the development and use of a transportation corridor. Regardless of the expansion of transport corridors, the risk for transmission of vector related disease is low in the Project area.

Potential Vector Borne Disease Impacts

It is anticipated that impacts related to vector related disease will be felt in the short-term, be localised and have a negligible health effect. It is improbable that these health consequences will occur, representing an overall **negligible health impact significance**. The impacts are unpredictable, may occur at any time of the Project life cycle, and could affect Gndevaz, Gorayk/Saravan and Jermuk PACs.

The Project will transport some construction and operations employees and contractors between Yerevan and the Project site on a regular basis, increasing the opportunity for disease transmission from one region to the other. In addition, the Project may import goods through Georgia, increasing transport between these areas and the Project region.

Mitigation Measures for Vector Borne Disease Impacts

This impact is considered **negligible** and does not require mitigation. Health records could be monitored to ensure no changes are occurring to the health profile of the region as a precaution. Gender specific impacts are not anticipated.

Residual Vector Borne Disease Impacts

The short and long term residual vector borne disease impacts are **negligible.**

6.18.6 Soil, Water and Waste Related Diseases

Project Activities Affecting Soil, Water and Waste Related Diseases

The major contributors that could affect soil, water and waste related diseases include direct Project activities involving earthworks and inadequate wastewater management, and indirect factors such as the in-migration of people placing pressure on the already limited basic services.

Gndevaz, Saravan, and especially Gorayk, currently have limited access to potable water sources, independent of the Project. Jermuk/Kechut has better access to potable water. Sewerage systems in the rural communities are limited, with Jermuk having access to a wastewater management system (this system was recently upgraded and now has a design capacity for 18,500 people, although it only includes a mechanical separation plant at the time of writing of the ESIA).

Domestic garbage management is poor, with Lydian supporting collection and disposal in the study area as part of a social contribution. A landfill for non-hazardous waste will be developed by the Project to the eastern side of the BRSF. Unless a suitable municipal landfill is developed by Jermuk, all domestic waste generated by the mine, temporary camp (built for duration of the construction phase) and by workers residing in Jermuk will be disposed of in the landfill built at the mine site. Hazardous waste generated by the Project will be minimised and that which requires disposal will be contained in a designated hazardous waste storage facility located adjacent to the ADR Plant. If feasible, a waste incinerator will be procured.

Sewerage generated from the plant, office buildings, crushing plant, and truck shop will be managed by septic tank systems, with effluent disposed of in accordance with local regulations and IFC EHS guidelines. The design of the temporary camp will include a packaged wastewater treatment plant. Plans have been developed for septic sanitation facilities in in different Project work areas, with adequate numbers of male and female facilities.

Potential Soil, Water and Waste Related Disease Impacts

It is anticipated that impacts related to soil, water and waste related disease will be felt in the medium term, be restricted to the study area, and have a minor negative health effect. It is possible that these health consequences will occur, representing an overall **moderate negative health impact significance**. The impacts are anticipated to occur in the construction phase, but will persist to a lesser degree into operations. Jermuk, Saravan, Gndevaz and the seasonal herders are anticipated to be most impacted. Gender related impacts are not anticipated.

The Project development has the potential to impact community health related water quality and waste/sanitation in the following direct and indirect manners:

Direct:

- Contamination and / or redirection of the surface water (rivers, streams), springs and superficial groundwater from construction activities and mining operations. Contamination may also occur from the naturally occurring chemical composition and associated mineralisation of parent soil or superficial rock material. This potential direct impact is linked to environmental management, and is discussed further under environmental health determinants in Section 6.18.11.
- Contamination of surface as well as superficial groundwater sources and soil from the generation of sewerage, spills and solid waste from the Project's activities.
- Cessation of water springs used by herders.
- The capacity of local services in Jermuk to accommodate additional demand has been assessed and, an allowance has been considered for a 500-920 person camp being built and used for the peak periods during the construction period to allow the project to reduce the additional load on public utilities. Service capacity in Jermuk is further addressed in Section 6.12 and 6.14.
- It is not anticipated that the Project will induce any health impacts through the abstraction of water for Project related needs.

Indirect:

- In-migration of migrants or returning citizens to the area may place pressure on the already limited supplies of potable water and waste management facilities in the broad study area. This can result in the potential for increased disease risk, especially diarrhoeal diseases, as well as for social discord due to increased demand for what is a scarce resource. This is however, unlikely, as large-scale and sudden in-migration that could place stress on existing systems is not anticipated. The potential for these impacts to occur is further considered in Section 6.12.
- Unplanned development that may occur with rapid increases in population has the potential to contaminate surface and superficial groundwater sources in a similar manner, but as mentioned, this is unlikely.

- Increased demand for services within Jermuk linked to accommodation of up to 370 workers during construction and 250 workers during operations will place additional pressure on these systems. Effective resolution, working in coordination with Jermuk Municipality, of waste management and wastewater treatment challenges facing Jermuk will be required.

Mitigation/ Enhancement Measures for Soil, Water and Waste Related Diseases

These potential impacts will be managed through the following measures:

Project impact mitigation:

- Water quality management as part of the Project's environmental management plan, surface water management plan (contact and non-contact water) and water use licence. This will include surveillance of community water sources and supply (including water sources used by herders).
- Effective communication strategies with the local communities on water and soil quality will be developed. This needs to include transparent reporting of water quality results from the Project's water monitoring program and effective communication thereof (see the Surface Water Management Plan in Appendix 8.23). Participatory monitoring of water quality has been established and will be continued by the Project.
- Infrastructure and systems will be developed, and locations selected, to ensure that domestic water use, sewerage and domestic waste management by the mine will not adversely affect available water supplies in the PACs.

Occupational health, safety and environmental management:

- Conduct information, education and communication (IEC) campaigns in the workforce and with the community on proper water use, hygiene and sanitation to prevent pollution of community water sources.
- Ensure work areas have adequate potable water supply and waste management facilities. This needs to include security guards or other staff stationed in remote areas of the mine. Portable chemical toilets should be provided as required to prevent the need to use the environment for ablution activities.
- As part of the use of hotel accommodations in Jermuk, ensure that there is adequate potable water availability as well capacity to manage wastewater and domestic garbage.

Residual Soil, Water and Waste Related Diseases Impacts

Effective and sustained implementation of the mitigation measures described above is anticipated to support a minor negative health impact, in the short term at a study area level. These impacts are possible, with a potential **minor negative health impact significance with mitigation.**

6.18.7 Sexually Transmitted Infections (including HIV/AIDS) and High Risk Sexual Practices

Project Activities Affecting Sexually Transmitted Infections (including HIV/AIDS) and High Risk Sexual Practices

The Project will influence the increased transmission of sexually transmitted infections (STIs) through the "four m's" of "men, money, mobility and mixing". This is an acronym that is often used to describe the influence of extractive industry development and determinants that may influence an increased risk for the transmission of STIs.

The study area is reported to have a low current prevalence and incidence of HIV/AIDS, and other STIs. All HIV/AIDS cases currently under care in Jermuk were reportedly infected while working as migrant labourers in Russia.

Key Project activities that may influence this health outcome include:

i) the location of workers in accommodation in hotel accommodation and a temporary construction camp;
ii) the origin of workers (including contractors, expatriates and visitors) especially those from outside the immediate study area;
iii) the transportation corridors used by the Project;
iv) gender balance of employees/contractors; and
v) migrants who move into the Project area.

Potential Sexually Transmitted Infections (including HIV/AIDS) and High Risk Sexual Practice Impacts

It is anticipated that impacts related to STIs may be felt in the long term, have regional effects with a predicted major negative health effect. It is possible that these health consequences will occur, representing an overall **very high negative health impact significance**. The impacts are anticipated to occur in the construction phase, and will persist into operations. Jermuk, Gndevaz and communities along the transport network are the PACs who are likely to experience the most significant impacts, but Gorayk, Saravan and seasonal herders may also experience impacts. Women and young girls are likely to be more vulnerable to these impacts than men.

Direct:

- **Transport Corridors:** There is the potential for increased high-risk sexual encounters along the transport corridors to the Project. Transport workers are a well-described high-risk group, known to have multiple sexual partners and to develop sexual networks along transport corridors. These can include long distance truck drivers as well as drivers of light duty vehicles. There is thus the risk of transmission of STIs along the transport route as well as in the local communities, especially if truck stops develop in the communities around the Project.

  This potential risk can allow for the mixing of the virus with new strains introduced from other areas. This can have public health implications as resistant strains may be introduced from other areas with implications on national anti-retroviral therapy (ART) strategies.

- **Increased disposable income:** People (generally men) who benefit directly and indirectly from the Project may have more money available to partake in forms of transactional sex. The poor and vulnerable sectors in the community may be more susceptible to advances for opportunistic transactional sexual encounters with the risk of a "sugar daddy" phenomenon developing, where men that have disposable income entice young girls, who are vulnerable through poverty and lack of opportunity, into transactional sexual relationships.

  In addition, increased incomes in the local community, especially in those employed by the Project may increase the incidence of transactional sex in their host communities. This will then pose a risk to their normal family unit with potential increased transmission of STIs, and with local women again a specifically vulnerable group.

  The temporary construction workforce is a high-risk group as they will have disposable income with limited entertainment opportunities. Those workers residing in the temporary camp (between 500-920 workers) will have limited exposure to communities, minimising this risk. However, up to 370 workers may reside in hotel accommodation in Jermuk during the peak of construction making commercial and transactional sexual relations likely in the communities in the study area.

- **Workforce mixing with the local population:** Approximately 70% of the temporary construction workforce are expected to be sourced from outside of the study area, as the local community is not expected to have the requisite skills to support all the required activities. In general, construction workforces are mobile and move from site to site, often in different regions. Due to potential high-risk practices and behaviours, these groups often have higher rates of STIs and HIV, and are thus a high-risk group that have the potential to transmit STIs in the local community, even if for a short period.

  In addition, these workers are often in remote settings away from their normal partners for extended periods, and thus casual sexual relationships (with multiple sexual partners) are commonplace. Rotational work, with limited entertainment opportunities, means that they often have little means to spend cash they earn locally, and thus disposable income may be used in return for sexual favours.

  The hotel accommodation and the onsite camp are thus potentially high-risk, with the temporary construction workers likely to seek entertainment opportunities in the towns and villages in the study area, with Jermuk and Gndevaz particularly at risk. This risk is being mitigated in part through project design choices, with the construction camp operating as a closed facility, thereby reducing interaction between rotational construction workers and local communities. However, restrictions of intermixing between workers accommodated in hotels in Jermuk and residents of Jermuk and other villages is unlikely to be fully feasible, due to the open nature of accommodation arrangements. Taverns and similar establishments may develop and with substance abuse, may become areas where high-risk sexual encounters are initiated.

  In addition, the planned accommodation of workers in Jermuk town will place this community at specific risk. Hotel and catering staff, especially cleaners, reception staff and restaurant staff may be specific risk categories. Knowledge of the hotels and the financial status of the workers may attract “formal/professional” commercial sex workers (CSW) to the area. This group may have a higher STI disease burden than the local community, which may lead to increased transmission of STIs in the study area. This is described further below.

Indirect:

- **In-migration to the area in returning and new migrants** can result in mixing of people with higher disease prevalence with local residents that may have a lower prevalence of disease, as well the introduction of different viral strains locally. This may include returning citizens or migrants from countries that have higher circulating rates of HIV and STI, including Russia, Kazakhstan and other eastern European and Central Asian countries. Figure 6.18.2 below underscores this risk by depicting that the Central Asia region has experienced a more than 25% increase in HIV prevalence from 2001 to 2009 (in red), with UNAIDS reporting the region as a concern due to the increasing rates[3].

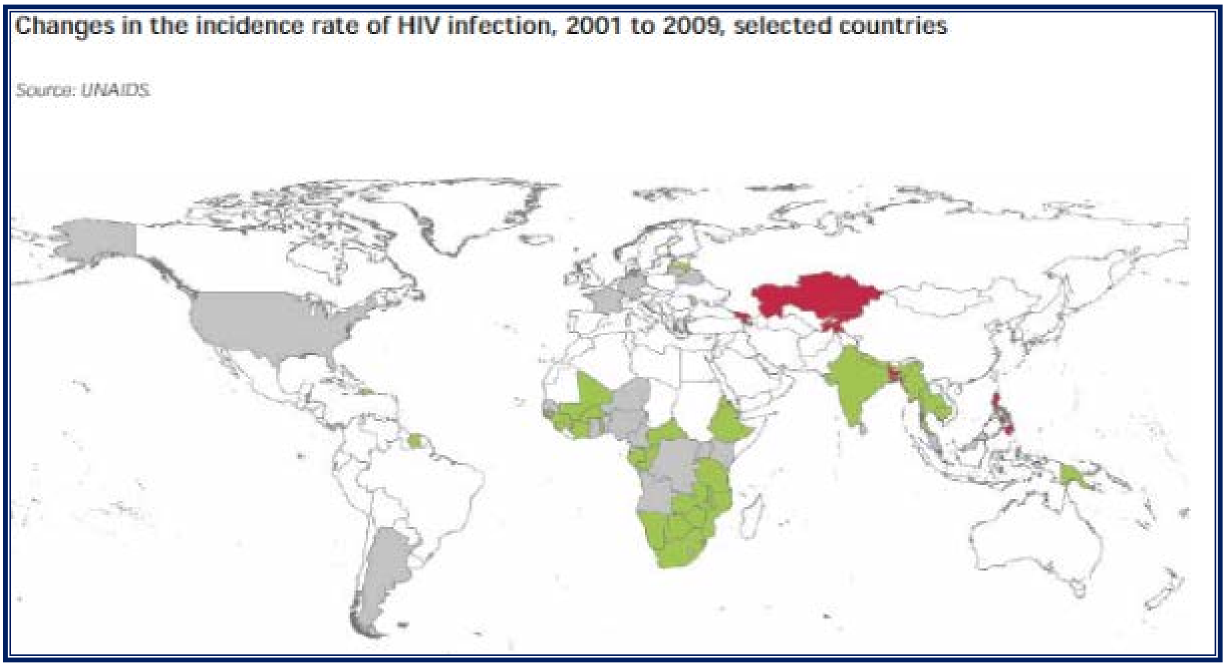

Figure 6.18.2: Increasing Trends of HIV Infection in Central Asia

- **Development of a local commercial sex industry:** The commercial sex industry in

[3] Knowledge, Attitudes and Behaviour Related to HIV/AIDS among Transport Sector Workers - A Case Study of Georgia. June 2008. Published with World Bank Europe and Central Asia Region. Retrieved on 25 October 2011 from url: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTHEALTHNUTRITIONANDPOPULATION/EXTHIVAIDS/0,,contentMDK:21735886~menuPK:376477~pagePK:148956~piPK:216618~theSitePK:376471,00.html

Armenia is well described. This is supported by the challenging economic situation, migration of men out of the country with a lack of men for women to marry, poor upbringing due to poverty and a decline in moral values[4]. There is potential that the Project will be an attraction to outsiders, including CSWs who may look to benefit from the improved economy. While they may target the mine workforce, the social implications may be experienced in the broader community.

Jermuk, with its existing tourist attraction will be at higher risk for this potential and the accommodation of a portion of mine workforce in this town may enhance this (as described above). This has the potential to impact the tourist attraction of the town, especially for families. CSW may bring about other social ills such as alcoholism and drug abuse including injecting drug use.

Mitigation/Enhancement Measures for Sexually Transmitted Infections (including HIV/AIDS) and High Risk Sexual Practice Impacts

These potential impacts will be managed through the following measures:

Project Impact Mitigation:

- A clear HIV policy and programme in the workplace and community has been developed (see Appendix 8.4b).
- Support for in-migration management planning with the local town and village authorities and Marz level administrators as appropriate.
- Thorough implementation of Lydian's Code of Conduct and corporate policies as they actively discourage the external fraternisation of the workforce with the local community. This is especially important in Jermuk as well as the other surrounding communities.
- Develop if needed a specific code of conduct for contractors that discourages sexual relations and prohibits sexual harassment within the workforce, especially towards female employees that originate from the local community. This should extend where possible to cleaning and catering staff in Jermuk hotels.
- A closed and dry camp policy be implemented during the construction period. Adequate entertainment facilities will be developed to reduce the need to travel out of the camp. Entertainment facilities will also need to be made available for workers

[4] Report on Some Aspects of Commercial Sex Work in Armenia. 2001. Retrieved on 14th March 2012 from url: *hopehelp.am/.../Report%20of%20CSWs%20eng%20_book_.pdf*

residing in Jermuk hotel accommodation.

- Contractor management with clear and enforceable sanctions for breach of conduct will be established.
- Limit the development of truck stops in the local communities. Either accommodate transport workers in identified parking areas, or in the temporary construction camp, or develop procedures to limit overnight stops in local communities, including Jermuk.
- Develop support programmes for women working in hotels and other recreational establishments in Jermuk to reduce risk of transactional sex. This will need to include support from owners of the establishments.
- Monitor any increase in CSWs - especially in Jermuk - and work with local authorities to uphold local legislation and by-laws. The development of a baseline of CSW activities should be a condition subsequent to the ESIA so monitoring can be performed effectively.
- HIV and STI prevention programmes for long distance truck drivers and drivers of light duty vehicles. This will require contractor support and management. Education and awareness programmes will be important to develop.
- In the operations phase promote family friendly accommodation at the Project. This will be achieved through promoting training opportunities and local recruitment in the operation phase allowing employees to reside with their families. Rosters for non-residential workers will be designed to ensure they spend a sufficient amount of time with their families.
- Develop a CHIS on key HIV and STI indicators from longitudinal data sources.

Occupational Health, Safety and Environmental Management:

- Develop a HIV and STI management programme in the workforce. It is essential that this be developed prior to construction so the incoming construction workforce can be effectively targeted with appropriate prevention programmes. Where possible and relevant the HIV programme should be integrated into the activities of the local health services and in close cooperation with the Ministry of Health.
- Widespread availability and social marketing of condoms in the workplace and accommodation areas. Consider condom distribution programmes in local restaurants and entertainment areas where sexual transactions are likely to take place.

Social Development Mitigation and Management:

- Support local IEC campaigns on HIV and STI awareness that promote behaviour change;
- HSS to support the functionality of the local health care services so that the community attend the facilities for the effective management of STIs; and
- Support women's empowerment and education programmes to avoid the temptation to be involved in forms of transactional sex work.

Residual Sexually Transmitted Infections (including HIV/AIDS) and High Risk Sexual Practice Impacts

Effective and sustained implementation of the mitigation measures described above is anticipated to reduce the consequence of impacts to a moderate negative health impact, in the medium term, but still at a regional level. It is possible that the impacts will still occur, with a residual **moderately negative health impact significance.**

6.18.8 Food and Nutrition Related Illnesses

Project Activities Affecting Food and Nutrition Related Illnesses

Food security and malnutrition is not a major concern in the study area.

Access to land to support agriculture or animal husbandry is a key element in local livelihoods, as it supports local subsistence nutritional requirements and generation of cash from sales. Increasing food prices, particularly in staple foods have placed pressure on affordability of food nationally with vulnerable groups more susceptible.

Reduced access to land, inflation and an improved local economy will all play a role in Project impacts associated with food and nutrition.

Potential Food and Nutrition Related Illness Impacts

It is anticipated that impacts related to food and nutrition may be felt in the short-medium term, be restricted to the study area, and only have a minor negative health effect. It is possible that these health consequences will occur, representing an overall **minor negative health impact significance**. The impacts are anticipated to occur in the construction phase but will persist into operations. Gndevaz, Jermuk, Saravan and Gorayk, as well as seasonal herders are anticipated to be most impacted. Gender specific impacts are not anticipated, but poor people and those with restricted access to land may be more vulnerable.

The following potential impacts have been identified:

Direct:

- Land take by the Project with reduced land available for agriculture and to graze livestock. A detailed description of land required for the Project is included in Section 6.15. While much of this land is used for grazing, restricted access to this land is not expected to have a significant impact on food availability.
- Land take is also affecting commercial and subsistence crops, e.g. apricots and wheat, therefore affecting livelihoods. This impact is addressed from a livelihoods perspective in Section 6.14. It is not expected to generate a significant impact on food availability.
- Increased food consumption (workforce) from onsite catering facilities and hotel kitchens may potentially lead to an increase in obesity and non-communicable diseases. The type of foodstuff will also be an important predictor in this potential impact.

Indirect:

- The development of the Project will alter the economics of the study area with potential positive and negative impacts:
    - A potential benefit may be the provision of meals at work for employees and contractors. This initiative may produce a well-worker effect through a balanced diet and may free up some disposable income to improve nutrition in the community. However, a potential negative may be the transition from traditional home grown foods to processed and commercially packaged foods, leading to a potential increase in non-communicable diseases.
    - Negative impacts may be associated with food inflation in the study area, because of supply and demand and from the improved local economy and ability to afford different products.

Jermuk will especially be at risk for food and other inflation because of the accommodation of the externally hired workforce in this town. This section of the workforce will have disposable income and thus have the ability to afford goods and products for sale in town. There is the potential that the other communities in the smaller towns may also be impacted through inflation of basic food products. This may increase the costs for general and even basic commodities with the vulnerable section of the population potentially not able to afford price increases resulting in potential food insecurity.

Mitigation/ Enhancement of Food and Nutrition Related Illness Impacts

The following mitigation actions have been identified:

Project Impact Mitigation:

- Monitor food inflation in the study area, with a specific focus on Jermuk and the other small towns. Basic and staple commodities should be used as key indicators;
- Ensure adequate access to agricultural land for the production of local produce and grazing of animals. Minimize disturbance to animals by limiting restrictions of access to mining and immediate surrounding area while maintaining a safe boundary between community access and industrial activities. This is also considered in Sections 6.8 and 6.11;
- Undertake specific nutritional surveillance in children and adults using data from the local health centres. This data should be fed into the proposed CHIS;
- In-migration management and support with local economic develop initiatives.

Occupational Health, Safety and Environmental Management:

- Ensure meals provided by the Project are subject to a clear menu that promotes a balanced diet, healthy eating options and restriction of portions. Ideally a dietician should provide input into the menu.
- IEC programmes and nutritional programmes at the workplace to promote proper feeding practices to prevent obesity and NCD.

Social Development Mitigation and Management:

- Continue to support programmes that promote local farming practices to increase yields through improved farming techniques as described in the livelihood restoration plan; and
- Promote access to markets for locally produced produce to support the local livelihoods. This will stimulate local economic development and support food security.

Residual Food and Nutrition Related Illness Impacts

Through sustained and effective implementation of the mitigation measures outlined above, the residual food and nutrition related illness impacts are considered to be **negligible** both in the short and long term as the impacts will be minor, occur for a short term, be localised and not likely to occur.

6.18.9 Non-Communicable Diseases (NCDS) Linked to Lifestyle Changes

Project Activities Affecting NCDs Linked to Lifestyle Changes

NCDs are the biggest health challenge in Armenia and a major contributor to the burden of disease. Cardiovascular disease, diabetes and cancers are major contributors with obesity, smoking and alcohol abuse all modifiable risk factors. The prevalence of hypertension is over 50% in the general population.

The development of the Project is unlikely to have a significant direct role per se in increasing the burden of disease but factors affecting lifestyle and demographics may cause indirect impacts.

Potential NCD Impacts Linked to Lifestyle and Demographic Changes

It is anticipated that impacts related to NCDs will be felt in the long term, be restricted to the study area, and have a minor negative health effect. It is possible that these health consequences will occur, representing an overall **moderate negative health impact significance**. The impacts are anticipated to occur in construction but will persist into operations and even into the closure period. Jermuk, Gndevaz, Saravan and Gorayk, as well as seasonal herders are anticipated to be most impacted. Gender specific impacts are not anticipated.

The following indirect impacts are considered:

- **Increased disposable income with current lifestyle practices:** As mentioned the development of the Project is likely to generate some economic spin-offs and may increase the amount of disposable income at the household level. Unfortunately, this may serve to support the existing poor lifestyle practices in the community with increased smoking, limited balanced diet, and a lack of exercise. These can in turn cause an increase in NCDs.
- **Increase of NCDs in the workforce**: The workforce that is hired for construction and operations will be especially susceptible to the effects of NCDs. They will have an increased disposable income and the benefits of working at the mine will include meals and other benefits. The workforce who will also be hired from the community may thus be susceptible to the risks of NCD with the following potential impacts:
    - High costs associated with absenteeism due to ill health;
    - Loss of trained or skilled people from the workforce because of disease. This will result in higher operational costs due to the need to retrain or recruit replacement staff, and

- Impact on the family unit with potential social and behavioural impacts.

Mitigation/Enhancement Measures for NCD Impacts Related to Lifestyle Changes

Even though the Project is not anticipated to impact NCDs linked to lifestyle changes, opportunities exist to enhance the management of NCDs in the Project area, especially linked to workplace wellness programmes.

The following mitigation actions have been identified:

Project Impact Mitigation:

- Support IEC programmes as part of community based outreach programmes with a focus on modifiable lifestyle factors such as diet, exercise, smoking, oral health and alcohol consumption. These should be done in partnership with the local public health authorities, in association with local agencies or NGOs.

Occupational Health, Safety and Environmental Management:

- As part of the medical surveillance activities in the workforce, screen for NCDs. This is an important fitness for work requirement and should be incorporated into the occupational health programme as an essential health promotion intervention. Surveillance of weight or body mass index (BMI) as a predictor can be used and screening for hypertension, cholesterol and diabetes should be routine in high-risk groups, especially those operating heavy or mobile machinery.
- Initiate wellness programmes in the workplace for the prevention of chronic diseases through management of modifiable risk factors.

Social Development Mitigation and Management:

- Promote well-being and healthy lifestyle programmes in the communities through different planned interventions.
- Support with HSS that promotes health seeking behaviours to the formal health sector so that medications are routinely collected and follow-ups are adequately performed as per national guidelines. There is an opportunity to support the existing Oxfam and UMCOR programmes.

Residual NCD Impacts Linked to Lifestyle Changes

Through sustained and effective implementation of the mitigation measures outlined above, the residual NCD impacts will bring about a probable moderate health benefit in the long term, but at a localised level. It is possible that these impacts will still occur, with a residual **moderately beneficial health impact significance.**

6.18.10 Veterinary Medicine and Zoonotic Diseases

Project Activities Affecting Veterinary and Zoonotic Diseases

While zoonotic diseases are unpredictable and have a significant outbreak potential in the study area, the Project is unlikely to influence the risk of transmission of these diseases in any significant manner. In fact, it is likely that the Project may actually reduce the seasonal movements of animals/livestock in the immediate study area. This in itself is not likely to play a meaningful role in reducing disease risk from the prevailing baseline. Gender specific impacts are not anticipated.

6.18.11 Environmental Health Determinants

Typically, in this section, impacts associated with environmental health determinants such as noise, water, air pollution and visual impacts are assessed. The assessment also considers exposure to heavy metals, hazardous chemicals substances, exposures to mal-odours, as well as radiation impacts. Many of these topics have been assessed in detail in the environmental impact assessments and associated specialist studies and are not repeated here with the exception of:

i) exposure to hazardous chemical substances;

ii) soil contamination and potential exposure to heavy metals, and

iii) radiation risks.

For clarity, the locations of the specialist studies are summarised here:

- Water Quality and Quantity – Section 6.9 and 6.10;
- Noise and Vibration – Section 6.7;
- Landscape and Visual Amenity – Section 6.5;
- Hazardous Chemical Substances – this section;
- Air Quality and Mal-odours – Section 6.6;
- Radiological risk assessment – this section;
- Food chain risks from dust and groundwater – this section; and
- Safety risks associated with earthquakes and blasting – this section.

Not all of the topics captured in this EHA will be affected by the Project; however, they have been raised as concerns by stakeholders during the consultation process. This includes radiation impacts and food chain risks through soils and groundwater. The Project has responded to these concerns through public consultation processes and through the provision of reports specifically targeting stakeholder concerns. Technical assessments of the human health risks associated with these concerns are described where relevant in this section. For clarity, these concerns are addressed from a technical standpoint and do not follow the same structure as is applied to Project generated impacts.

Hazardous Chemical Substances Risks

Potential Impacts Associated with Hazardous Chemical Substance Risks

A number of potentially hazardous chemical substances (HCS) will be used or generated because of Project activities. Sodium cyanide is the most important of these, with its use in the recovery of gold in the HLF. Cyanide is toxic to humans and other living organisms even at low concentrations. It will thus be important to manage cyanide across the supply, storage and use chain as per the requirements of the International Cyanide Management Code (ICMC). This will include transport to site, storage on site, handling in the HLF, and spill response as well as waste management. Lydian is committed to become a signatory company of the ICMC.

In addition, the mercury that is present in the ore and that will be produced in the process phase needs to be considered in relation to its potential impact on human health. Based on designs this will be effectively managed within the framework of the Project's Waste Management Plan with minimal risk for environmental exposure that may affect the community health. However, as there may be workplace exposures these will need to controlled as part of the Project's occupational health and hygiene management plans, to include the potential for community exposure (usually close family) as a result of contaminated personal protective clothing.

Other HCS that require evaluation based on their use and risk to human health include:

- The geological, assay and environmental laboratories;
- The site based infirmary with cleaning agents and other chemicals as well as medications;
- Pesticides and cleaning agents as part of general management of onsite facilities;
- Hydrocarbons, mineral oils and other lubricants and products; and
- Glues or solvents used for hot splicing (vulcanization) of the conveyer belts or other applications.

These HCSs are likely to present a greater workplace risk exposure than a community health exposure and it is anticipated that the occupational health and safety plan will address these potential hazards and recommended procedures or systems to manage the associated risks. However, community health risks need to be considered including:

- Contamination of clothing at the workplace, which is not changed before returning home resulting in a potential exposure to the community and especially direct family members. This can include lead from the fire assay lab, mercury as described above, acids and other chemicals from the laboratory or plant, pesticides, oil etc.
- Spills in the community either during transport or from poor storage or handling onsite.

It is likely that additional HCS will be used on the Project as it develops and a risk assessment process should be followed that includes occupational and community health risks prior to the products being purchased. This generally needs to include environmental approval and should be managed by the supply chain manager as the gatekeeper with sign-off from each department (health, safety and environment) prior to purchase.

Potential Impacts Associated with Hazardous Chemical Substances

It is anticipated that impacts related to HCS will be felt in the medium term, may have regional effects with a predicted major negative health effect. It is possible that these health consequences will occur, representing an overall **major negative health impact significance**. The impacts are anticipated to occur in the construction phase, and extend into the operational and decommissioning period. There is the possibility that all PACs may be impacted. Gender specific impacts are not anticipated.

Mitigation Measures for Hazardous Chemical Substance Use

Effective management of hazardous chemical substances requires a comprehensive materials handling process, including procurement, transportation, storage and use. The following mitigation measures have been identified:

Project Impact Mitigation:

- Develop appropriate HCS management programmes in alignment with IFC PS3 guidance and EBRD and EU requirements;
- Implement training for staff to handle HCS, with a specific focus on cyanide handling and storage;

- Implement the cyanide management plan prepared and ensure that it is compliant with the International Cyanide Management Code (ICMC); and
- Support effective communication programmes with the community on the use, handling and risks of cyanide and mercury. This needs to be performed carefully so as not to cause alarm but to allay fears and misconceptions.

Occupational Health, Safety and Environmental Management:

- Develop a system to ensure that a detailed risk assessment is undertaken for all HCS prior to it being allowed on site and determine the specific human health risks that may potentially result from exposure to a product or by product.
- Provide personal protective equipment and clothing (PPE/PPC) to minimise exposure risks as appropriate. However, PPE and PPC need to be appropriate for the nature of the exposure and employees trained in appropriate use and handling.
- Staff that are exposed to HCS that may represent a risk if transferred off site and must shower and change their clothes prior to leaving site. Soiled PPC must be washed on site and not by family members off site.
- Ensure effective workplace cyanide monitoring and management programmes. A detailed hazard identification plan will need to be developed to manage cyanide management from supplier to site once a supplier is selected. Emergency preparedness and response planning will need to be included in the overall cyanide management.
- Medical surveillance (including biological monitoring) of employees handling HCS must be incorporated into the Projects occupational health and safety management system. This should include surveillance for lead and mercury as there may be limited exposures to these metals in assay labs and gold room. Occupational hygiene and exposure assessment of control systems will be an important element to have in place.

Residual Impacts Associated with Hazardous Chemical Substances

Effective and sustained implementation of the mitigation measures described above and the development of a comprehensive HCS management plan as part of the health and safety management system, should reduce the residual impact, in the short and long term, to a negligible level.

Soil, Water and Heavy Metal Exposure

Potential Impacts Associated with Potential Heavy Metals Exposure Risks

The baseline soils and land cover studies reported the following data from the soil chemistry in the study area:

- There is an absence of soil contamination from human activities (pesticides, fertilizers, coal fired power stations, other industrial activity etc.). It was not evident if lead was present in gasoline or in paints in the area (or other human sources).
- There was a presence of heavy metals in the soils of the study area, which reflected the naturally occurring chemical composition and associated mineralisation of parent soil or superficial rock material. The concentrations of six heavy metals were exceeded when considering the Armenian Maximum Allowable Concentration (MAC), United States Environmental Protection Agency (USEPA) and United Kingdom General Assessment Criteria (UK GAC) values, including the following findings:
  - Arsenic:
    - All samples (n=93) are above the USEPA and MAC values, with 27.5% of samples exceeding the UKGAC.
    - The likely source is from naturally occurring material from arsenic bearing rock.
    - It is likely that the arsenic is in an inorganic form but it was not clear if the metal is bioavailable to cause potential human health impacts.
    - It is noted that arsenic is associated with significant human health risks and regarded as one of the most toxic elements, especially in an inorganic form.
  - Lead:
    - 47.5% of samples exceeded MAC, but with nil exceeding USEPA or UK GAC values.
    - There was minor lead mineralisation from naturally occurring soils and mineralised zones.
    - Lead is considered one of the top four heavy metals that are most damaging to human health, especially to children.
  - Cobalt:
    - All samples exceeded MAC, with only 23 samples exceeding USEPA levels.
    - Minor cobalt mineralisation from underlying rock.

        - While an important trace element, high concentrations of cobalt do cause human health effects and it is regarded as a possible human carcinogen.
        - Uptake in plants can be very high, as soils contain high amounts of cobalt. These can be taken up by animals but cobalt does not biomagnify up the food chain.
        - Cobalt is metabolised through the kidneys and as it has a short half-life, detection is only accurate for a few days after exposure.
    - Copper:
        - All samples exceeded MAC, with no samples above USEPA or UK GAC thresholds.
        - Minor levels reflecting underlying mineralisation in local soils.
        - Copper is not readily available for uptake by plants, with only a few plant species surviving in copper rich soil.
        - Copper is an important trace element for human health and while humans can handle large concentrations of copper very high levels can cause human health concerns.
        - Sheep suffer a lot from copper exposure, even at low concentrations but this does not biomagnify in the food chain.
    - Nickel:
        - All samples exceeding MAC, with no samples exceeding USEPA or UK GAC levels.
        - Often associated with cobalt and copper.
        - Plants are known to accumulate nickel, but as with other metals described above, it does not biomagnify.
        - Significant potential health consequences including a potential carcinogen, cause of birth defects, and lung/heart disease.
    - Antimony:
        - One third of samples exceeded MAC, with 8% of samples exceeding USEPA levels.
        - Probably originates from minor naturally occurring mineralisation from parent rock.
        - Inhalational route with antimony bound to hydrogen in gaseous form is what mainly causes health effects. Thus, exposure from Project activities is highly unlikely.

- In addition to the naturally occurring heavy metal exposure, it is important to understand the potential for acid rock drainage (ARD) that may be associated with Project activities as this may be associated with an increased risk to leach heavy metals from barren rock and ore. Studies for potential impacts associated with ARD found:
    - The main sources of ARD during operations will be:
        - Pit dewatering water;
        - Runoff from the BRSF;
        - Seepage from the BRSF; and
        - Seepage from backfilled barren rock in the Artavazdes and Tigranes pits.
    - There is minimal potential to leach metals from the barren rock storage facility.
    - There is a high acid generating potential and metal leaching potential from the ore body, but preliminary tests on heap leach residues indicate that there is a limited likelihood that ore material will be acid generating.
    - Certain materials that may be used from borrow pits may be acid generating.
    - Leach testing showed:
        - Short-term leach tests results showed that effluent is not likely to contain the six heavy metals discussed above as naturally occurring in soil or surface rocks.
        - Long-term leach test results indicate that lower volcanic samples have potential for ARD and long-term metals release, including arsenic cadmium, copper and cobalt.
        - Borrow material may result in leaching of iron, copper, manganese and barium but this depends on the type of material and potential for sulphide oxidation. This and future testing will direct the type of borrow material used to reduce the potential for leaching of these heavy metals.
- Surface Water
    - Surface water quality has been monitored since 2007 with a number of different metals and other parameters detected from different sampling areas including the following exceedances in heavy metals of concern:
        - Vorotan and Arpa Rivers: arsenic, cobalt, copper, chromium, nickel, lead and low pH. These samples are considered to reflect the influence of naturally occurring acid drainage and heavy metals from Amulsar Mountain.

        - Vorotan River and tributaries from the Amulsar Mountain: average pH is not significantly low in the immediate sampling area of the river, but mountain streams and tributaries are consistently moderately to highly acidic. Water quality in the river is better than the tributaries with cobalt, manganese, and barium exceeding MACs consistently in both the river and tributaries.
        - Darb River and tributaries: the Darb River showed near neutral pH with slightly acidic pH in the main tributary, with a separate tributary on the south-west flank of the mountain indicating strongly acidic surface water. Heavy metal analysis was similar to the Vorotan River, but with lead and nickel also detected.
        - Arpa Rivers and Tributaries: the water had near neutral pH, with heavy metal exceedances similar to other sites, including aluminium, barium, iron and manganese.
- Groundwater
    - Groundwater flow paths are away from Jermuk and the Kechut reservoir, but towards the settlements of Gndevaz, Saravan and Gorayk.
    - Some groundwater samples from Amulsar Mountain and Vorotan plateau have shown elevated levels of lead. In addition, nickel, copper and iron was detected above MAC from Amulsar Mountain.

This baseline provides insight into the potential for human health impacts to occur from heavy metal exposures from the naturally occurring material. However, exposure pathways to humans are vitally important, and a standard toxicological conceptual framework needs to be considered to determine if a significant health effect may be caused from a potential exposure.

On the current available data, it is not possible to determine if the naturally occurring heavy metals present in the soil or parent rock have contributed to any human health effects in the study area. Thus, it is not possible to describe an accurate point of departure of potential human exposure to heavy metals in communities at different exposure points. A plan is in place to carry out detailed village biomedical surveys in 2016 before the operations phase to gain additional baseline data.

The toxicological framework considers the following elements in determining the significance of potential human health impacts:

- The hazard's potency;
- The exposure level;
- Number of people exposed;
- Probability for exposure to occur; and
- Any modifying factors.

Due to the current lack of data, these five factors need to be considered in modelling potential future health impacts from the Project, and importantly, what the baseline exposure of heavy metals was in the general community in the study area prior to the commencement of the Project. The data presented above indicates the potential for exposure from a number of metals, with lead and arsenic the most significant from a human health perspective. Both metals occur naturally, but mining activities may increase exposures from barren rock, ore bearing rock and other material, and the potential for ARD may increase mobilisation of the metals in the presence of acidic water. Thus, to ensure that future environmental controls are effective (and can be monitored) it is important that the Project establish a robust baseline of human exposure before commencement of construction and operations. This will also support an understanding of the potential for exposures to occur in the future.

Potential Impacts Associated with Potential Heavy Metals Exposure

It is anticipated that impacts related to potential heavy metals exposure will be felt in the long term, with impacts in the study area, with a predicted a major negative health effect. It is possible that these health consequences will occur, representing an overall **major negative health impact significance**. The impacts are anticipated to occur in the construction phase, and extend into the operational and decommissioning period. There is the possibility that all PACs may be impacted. Gender specific impacts are not anticipated.

Mitigation Measures Associated with Potential Heavy Metals Exposure

Project Impact Mitigation:

- Environmental management as per the recommendations of the specialist studies on surface and ground water, soil and land use and ARD.
- Undertake in 2016 a baseline biomedical study in the PACs to determine the current exposures to heavy metals (study limited to arsenic and lead) that occur naturally in soil and water. This study will need to be performed with a local partner and preferably in association with the local health/environmental authorities. In addition, a statistical sample size will be essential to enable future comparisons and analysis of

samples must be completed at a laboratory with international accreditation.

- Develop an effective monitoring system that tracks potential environmental exposures from heavy metals. This can be supported by serial sampling of humans based on the same methodology applied in the baseline studies. However, the basis for surveillance using human sampling is to determine the effectiveness of environmental concerns, and is not a control in its own right due to ethical considerations.
- Develop effective communication programmes in the PACs to report on water and soil quality as well any results linked to human sampling.
- Work with the Marz and national health authorities in remedying any health concerns or conditions identified as part of the baseline examination or serial surveillance.

Occupational Health, Safety and Environmental Management:

- Effective environmental management.
- Effective occupational health and safety programmes.

Residual Impacts Associated with Soil and Heavy Metals Exposure

Effective and sustained implementation of the mitigation measures described above is anticipated to reduce the consequence of impacts to a moderate negative health impact, in the short term, and at a localised level. It is unlikely that the impacts will occur, with residual **minor negative health impact significance.**

Radiological Risk Assessment

Introduction

During operations, the Project will not utilize, store, or process radiologically active materials. Additionally, there are no industrial or anthropogenic sources of radiation in the Project area. In response to stakeholder concern, a radiological study was conducted to assess the potential for Project activities to affect the health and safety of workers and residents of surrounding communities.

During the 1970s the Amulsar area hosted Soviet geologists exploring for uranium; additionally, elevated concentrations of radon gas have been detected in some buildings in surrounding communities. Residents and local NGOs are specifically concerned that Project activities could potentially mobilize and concentrate naturally occurring radiologically active material present in local soils and rocks, in the form of both dust and radon gas.

Background

Lydian contracted with Radman Associates, a UK-based radiological safety consulting firm, to investigate radiological risk associated with the potential mobilisation of dust containing naturally occurring radioactive components ("radionuclides") present in the study area. The study focused on potential risks associated with radon, uranium, and thorium.

Radon gas is known to be present in the region and is of specific concern to local residents. As part of the baseline program, radon measurement was carried out in the surrounding communities (see Appendix 6.18.1). Certain buildings in the communities of Gorayk, Gndevaz, and Saravan registered elevated radon levels; radon-generating rocks are known to be present in the Project area. Radon is a naturally occurring inert gas that is colourless, odourless, and tasteless. Because it is heavy, radon gas tends to accumulate in basements and low parts of buildings. Radon gas is typically composed of two isotopes of radon: radon-222 and radon-220. These isotopes are formed as decay products of other naturally occurring radiologically active elements. Radon-222 is a decay product of uranium-238; radon-220 is a decay product of thorium-232. Radon gas is generated in rocks and soils containing these decay chain parent elements, and can escape through dissolution in groundwater and via cracks and faults in the overlying rock and soil layers.

Uranium is a naturally radioactive mineral that is commonly present in very small concentrations (a few parts per million) in virtually all soil, rock, and water resources worldwide (Argonne National Laboratory, Human Health Fact Sheet - Uranium, August 2005). Nearly all (> 99%) of naturally occurring uranium is present as the isotope uranium-238, which has a half-life of 4.5 billion years. Because of its extremely long half-life, uranium-238 is considered to have a low radioactivity. Uranium can be mobilized by water percolating through soils, and will preferentially adhere to fine-grained soils.

Thorium is another naturally radioactive mineral that is also commonly present in low concentrations in the Earth's crust, typically at around 10 parts per million (ppm or mg/kg - Argonne National Laboratory, Human Health Fact Sheet – Thorium, August 2005). In general, thorium is about three times as abundant in environmental media (soil, rocks, surface water and groundwater, plants, and animals) as uranium, or at about the same average concentration of lead or molybdenum. Virtually all (> 99%) naturally occurring thorium is present as the isotope thorium-232. At 14 billion years, the half-life of thorium-232 is even longer than that of uranium-238, and thus it is considered to have a very low radioactivity.

Thorium preferentially adheres to sandy soils, but unlike uranium it has a low solubility in water.

Data provided by Lydian from its exploration database of 81,939 rock samples indicate average uranium concentrations of 14.54ppm (mg/kg) and thorium concentrations of 5.13ppm in Project area rocks.

Risk Assessment

The Radman study focussed on potential risks associated with dusts bearing uranium-238 and thorium-232 and radon gas accumulation. Separate assessments were conducted to determine potential risks associated with exposure to dust and water-borne concentrations of uranium-238 and thorium-232 and for radon gas accumulation, for both workers and the general public.

It is anticipated that impacts related to radiation will be felt in the short term, be restricted to the study area and not contribute to any negative health effect above baseline. It is unlikely that these health consequences will occur, representing an overall **negligible health impact significance**.

Radman was supplied with uranium and thorium concentrations from soil and rock samples collected during Lydian's exploration program, including samples of both ore and waste rock lithologies. Soil and rock will be the main sources of dust during Project construction and operations. Radman analysed the data from 2399 soil and 46,964 rock samples to calculate maximum activity concentrations for the Project site soils and rocks. Radiologic materials are described by their activity, which is the number of nuclear decays per unit of time. The unit of activity is the Becquerel (Bq); one Becquerel is one decay per second. The calculated maximum activity concentrations are shown in Table 6.18.1.

Table 6.18.1: Maximum Activity Concentrations – Amulsar		
Project-Area Material Type	**Maximum Activity Concentrations, Bq/kg**	
	Uranium-238	**Thorium-232**
Soil	79	100
Rock	855	692

Data exists at the national level for activity concentrations of uranium-238 and thorium-232 in Armenian soils. Radman performed statistical analyses of the Project-area soils geochemical data to calculate mean, minimum, and maximum activity values; these statistics are shown in Table 6.18.2. For comparison, activity concentrations of natural Uranium-238 and Thorium-232 reported in soil in Armenia by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR[5]) are also shown in Table 6.18.2.

Table 6.18.2: Reported Levels of Uranium-238 and Thorium-232 in Soil				
Activity Concentration, Bq/kg	**Uranium-238**		**Thorium-232**	
	Armenia (UNSCEAR)	**Amulsar (Lydian)**	**Armenia (UNSCEAR)**	**Amulsar (Lydian)**
Mean	46	13	30	12
Minimum	20	1	29	1
Maximum	78	79	60	100

As can be seen from the table above, the maximum activity concentration for soils measured from the Project site are slightly in excess of the maximum values reported for Armenian soil. However, the mean values are lower, indicating that only a few of the 2399 soil samples analysed had elevated uranium and/or thorium concentrations, with the majority of samples being well within the reported Armenian natural values.

Uranium concentrations in the soil samples were evaluated against United States Environmental Protection Authority (US EPA) residential (red) and industrial (green) thresholds, as shown in Figure 6.18.3 below.

[5] United Nations Scientific Committee (UNSCEAR) 2000 Report on the Effects of Atomic Radiation to the National Assembly, Volume II Sources and Effects of Ionizing Radiation.

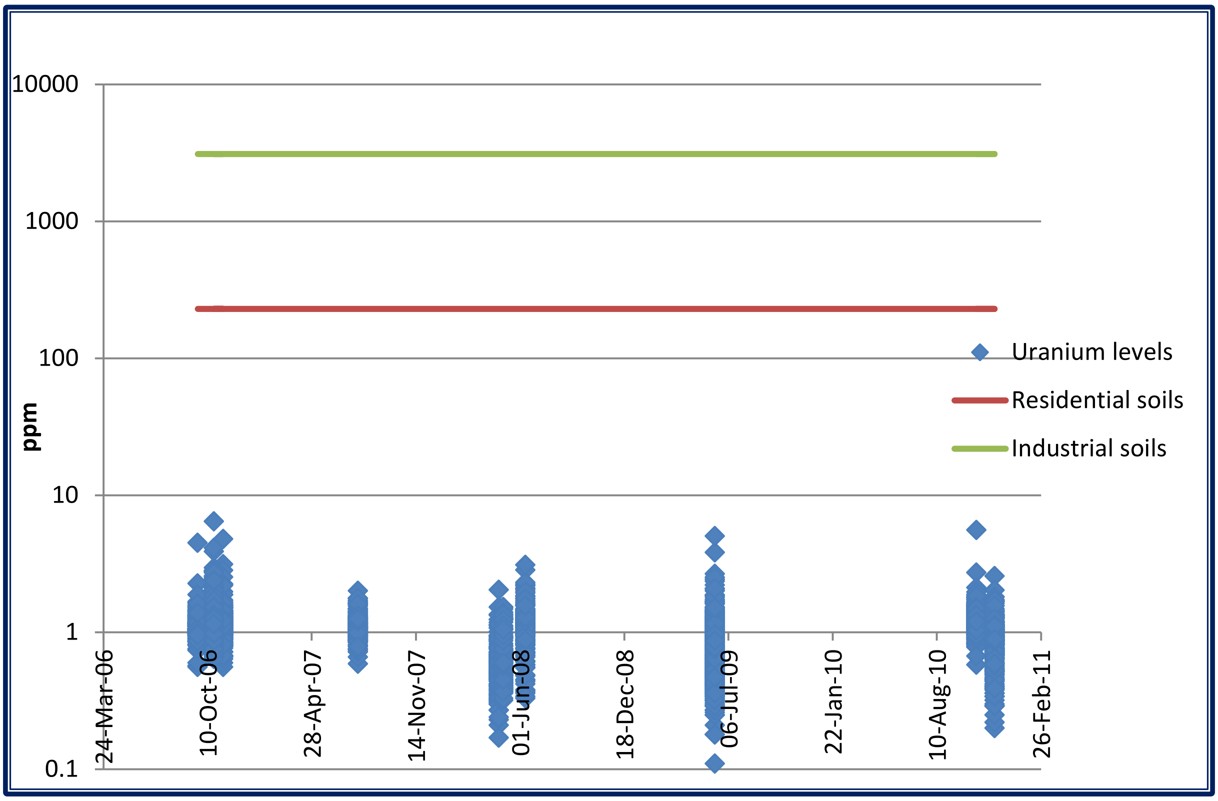

Figure 6.18.3: Uranium Concentrations in 2,400 Soil Samples at the Project Verses Soil Quality Thresholds from the US EPA

Pathways

The risk assessment considered the feasible potential pathways that uranium, thorium, and radon gas could become parameters of concern to Project workers and residents of surrounding communities. These pathways are summarized in Table 6.18.3.

Table 6.18.3: Qualitative Pathway Analysis for Naturally Occurring Radiological Exposure at the Project Site

Item	Potential Primary Pathway - Human Receptors	Comment
1	Soil ingestion (direct)	Not anticipated in quantity. Accidental only.
2	Inhalation – dust indoors: occupational exposure to rock crushing	Dust has the potential to be generated indoors from rock crushing.
3	Inhalation - dust outdoors: direct exposure to workers and members of the public from fugitive dust during soil and rock excavation, movement and processing.	Dust has the potential to be generated outdoors by mechanised liberation & passive window of soil & rock during excavation, transportation & deposition. Dust dispersion will be limited to 1 km from the source & therefore is not expected to reach community receptors. Refer to Air Quality Impact Assessment (Section 6.1).

Table 6.18.3: Qualitative Pathway Analysis for Naturally Occurring Radiological Exposure at the Project Site		
Item	**Potential Primary Pathway - Human Receptors**	**Comment**
4	Inhalation – radon indoors/confined spaces: gas rising from underlying geology or radon gas indoors)	Radon has the potential to be generated locally & migrate from substrate through fractures, poorly constructed floors & ventilation/service access points to accumulate in overlying structures.

According to the qualitative pathway analysis, direct inhalation of dust or radon gas is the primary applicable pathway to human receptors. The risk of direct ingestion of soil is considered to be very low and thus is not further evaluated here.

Uranium and Thorium Dose Assessment

To estimate the potential exposure to human health from naturally occurring radiological activity from soil and rock at the Project site, Radman conducted a dose assessment based on relevant Armenian and international standards. Armenian regulations are oriented toward industries that handle and process radioactive materials, rather than the lower concentrations found in situ at the Project site. In addition, Armenia only has a standard for worker exposure, and not one for general public exposure. Therefore, to estimate the potential exposure of Project workers involved in high-dust situations, a generic dose assessment was performed in accordance with United Kingdom Health Protection Agency (UK HPA) assessment tool for radioactively contaminated land (NRPB-W36)[6].

The dose assessment used the maximum uranium-238 and thorium-232 values measured in rock and soil samples collected from the Project site. Thus, this dose assessment provides conservative exposure estimates; actual exposures are expected to be lower. These doses were then compared to the current Armenian and United Kingdom dose constraints for both workers and the general public. The calculated exposure doses are shown in microSieverts per year (µSv/yr).

The basic quantity used to express the exposure of biological material to radiological activity is the absorbed dose, for which the unit is the gray (Gy). However, the biological effects per

[6] UK Environment Agency Radioactive Contaminated Land - Briefing Note 2 and 8, An Overview of Land Contaminated with Radioactive Substances and Land Contaminated with Radioactivity and the Principles of Radiation Protection (2007)

unit of absorbed dose vary with the type of radiation and the part of the body exposed. To take account of those variations, a weighted quantity called the effective dose is used, for which the unit is the Sievert (Sv). The effective dose is usually used to report levels of human exposure. The absorbed dose and the effective dose are typically termed the "dose", for which the units provide the necessary differentiation. Exposures can also vary as a result of human activities and practices[7] (Table 6.18.4).

Table 6.18.4: Regulatory Dose Limits

	Regulatory Dose Limits, in µSv/year	
	Armenia	**United Kingdom/IFC**
Workers	1,000	20,000
General Public	--	1,000

The UK dose limit for workers is 20,000 µSv/yr, which corresponds with the effective dose limit for the workplace (5 consecutive year average) according to the IFC EHS Guidelines (2007). The UK dose limit for members of the public in the workplace is 1000 µSv/yr. The Armenian "Rules on Protection Against Ionising Radiation and Safety of Ionising Source[6]" indicate that the worker dose limit for exposure from natural sources is equivalent to the UK public dose limit (1000 µSv/yr), which is in addition to the dose received from natural background, in the region of 2000 µSv/yr.

Assessment of potential construction worker exposure has been performed based on the maximum reported uranium-238 and thorium-232 activities in soil and rock and assuming an initial undisturbed, buried, uniform spatial distribution. It was further assumed that workers would remain exposed to the material for a full working year. The results are shown in Table 6.18.5. An effective dose of 63.4 µSv/yr was estimated (7.3 and 56.1 µSv y-1 from soil and rock respectively), which is well below the UK/IFC annual effective worker dose limit of 20,000 µSv[4]. The estimated exposure is also considerably within the threshold of 1,000 µSv/yr above which the UK Ionising Radiations Regulations 19995 (IRR99) would apply in full to the development, and the currently accepted dose constraint for a single site of 300 µSv/yr (Table 6.18.5).

[7] Rules on protection against ionizing radiation and safety of ionizing source. Supplied by Wardell Armstrong

Table 6.18.5: Effective Dose			
Project-Area Material Type	**Calculated Effective Dose, µSv/yr**	**United Kingdom / IFC, µSv/yr**	**UK IRR µSv/yr**
Soil	7.3	--	--
Rock	56.1	--	--
Total	63.4	20,000	1,000

Using ICRP7 inhalation and ingestion dose coefficients and UK National Radiological Protection Board (NRPB) habit data, estimated doses from inhalation and ingestion of dust from soil are 23.8 µSv/yr and from rock are 202 µSv/yr giving a combined internal dose of 225.9 µSv/yr, based on a 2000 hour working year. These estimated doses are again below the international dose thresholds as described above[4].

The estimated doses to workers are all significantly below the dose constraints for both workers (20,000 µSv/yr) and for members of the public (1,000 µSv/yr). Since potential dose estimations for members of the public be lower than for construction workers, no further dose assessments were deemed necessary and dose estimates for the general public are assumed to be well within guideline values[4].

The impact of dust generated by mining activities is assessed in Section 6.1. The dose assessments performed indicate that no doses in excess of the current UK/IFC dose constraints are expected as a result of the mining operation, from the uranium and thorium present in the rocks and soil at Amulsar. Thus, regardless of pathway, no impact on human or environmental receptors from radiological activity in dust is expected.

Radon Assessment

Household surveys for radon were conducted in households in the villages of Gorayk, Saravan, Saralanj, and Gndevaz. The measurements were taken in 149 locations in December 2010 until March 2011, during the lowest atmospheric pressure conditions when radon concentrations are likely to be at their most elevated. The results varied from 40 to 620Bq/m^3 and were notably higher in Gorayk. The monitoring location and range of results are shown in Figure 6.18.4.

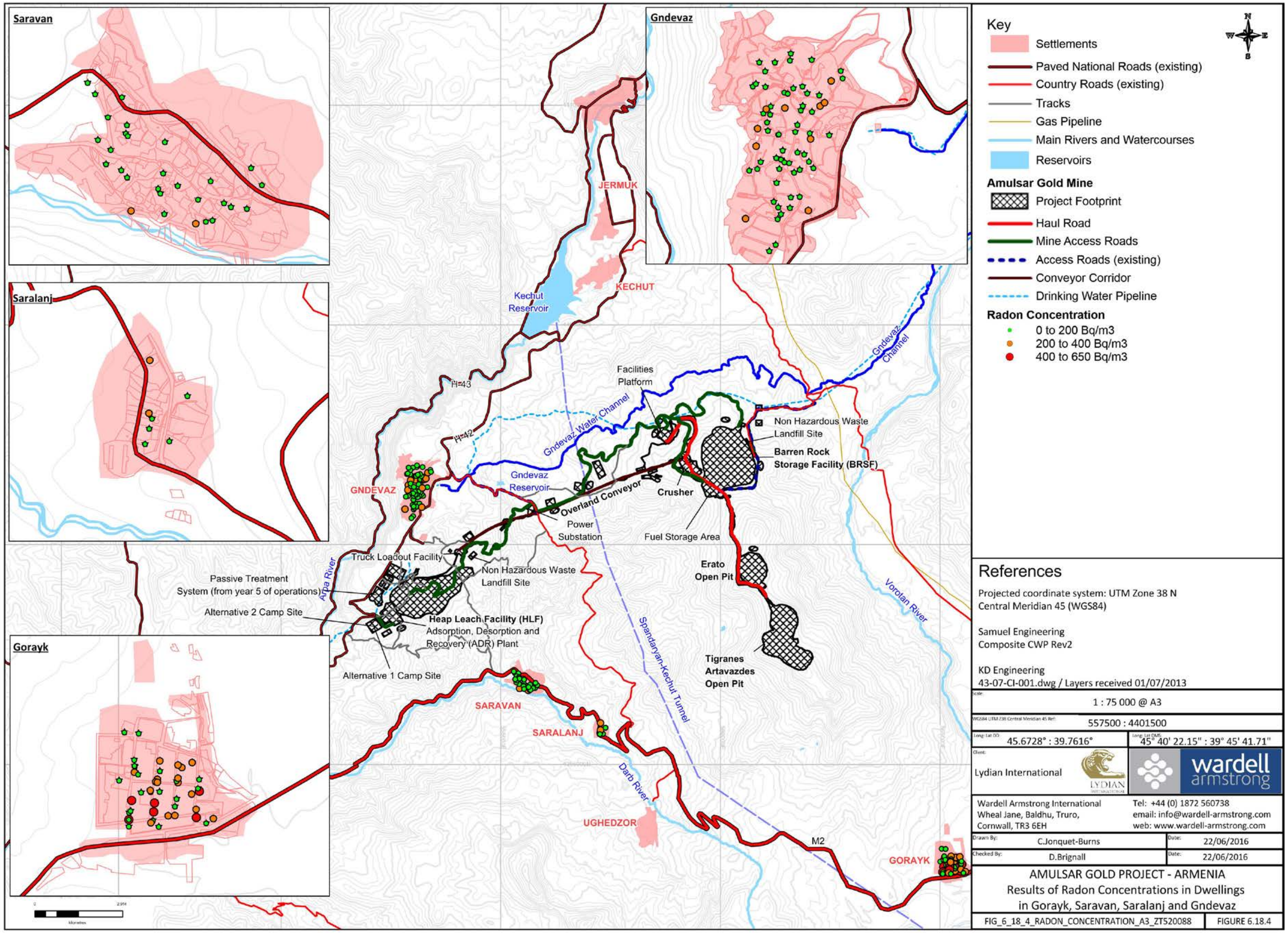

Figure 6.18.4: Results of Radon Concentrations in Dwellings in Gorayk, Saravan, Saralanj and Gndevaz

Armenia has no regulations regarding radon gas. Therefore, internationally accepted radon guidelines were considered for the radon assessment. The UK HPA recommends that radon levels should be reduced in homes where the annual average radon gas concentration is more than 200 Becquerels per cubic metre (Bq/m^3). The International Atomic Energy Agency (IAEA) and WHO consider 200-600 Bq/m^3applicable to basic safety standards for radiation. For radon gas, 200 Bq/m^3 is considered an appropriate conservative guidance threshold for a dwelling or for dormitories. In the UK, the Ionising Radiations Regulations (UK IRR, 1999) require action to protect employees in the workplace if the average radon gas concentration exceeds 400 Bq/m^3. Relevant radon guideline values are summarized in Table 6.18.6.

Table 6.18.6: Radon Guidance

	Radon Guidance, in Bq/m^3		
	UK HPA	**IAEA/WHO**	**UK IRR**
Home	200	200-600	--
Workplace	---	---	400

There are no existing buildings at the site, thus no radon concentrations were measurable at the Project site. However, there are measured radon concentrations in a minority of dwellings in Gorayk in excess of 400 Bq/m^3 and measured radon concentrations in dwellings in Gorayk, Gndevaz and Saravan in excess of the 200 Bq m^{-3} action level. Poor construction, use of radioactive construction materials and situation above radon-generating substrate can result in localised concentrations of radon gas exceeding the above referenced guidance.

Although not directly comparable to seismic activity related to earthquakes, concern has been raised by stakeholders regarding blasting at the Project that could produce an increased release of radon gas. This would occur without prior build-up, resulting in lower radon concentrations than those released during seismic activity and without any significant short-term increase in radon or additional exposure[4].

The impact of radon gas to worker health as a result of the Project is considered to be minor and can be easily avoided by incorporating protective and monitoring measures into Project design and operations. Herders tending animals in lands surrounding the Project site typically reside in loosely constructed and well-ventilated temporary dwellings that would not be conducive to the accumulation of radon gas, therefore potential impact to herders is considered very unlikely. The probability of blasting at the Project being able to trigger a seismic event is remote. Even so, the nearest community is situated beyond the distance of impact from blast vibration both during construction and operations, therefore the likelihood of blasting being able to influence radon migration is improbable. Taken together, the potential impact of radon gas as a result of the Project on these receptors is considered to be negligible.

Water Assessment

Radiologically active elements can emit alpha and beta particles as they decay. The activity of these particles in disintegrations per second can be measured in Bequerels and is commonly used as a measure of radiological activity in natural waters. The WHO screening levels for drinking water are 0.5 Bq/l for gross alpha activity and 1 Bq/l for gross beta activity. If neither of these is exceeded, the Individual Dose Criterion (IDC) of 0.1 mSv/yr (100 µSv/yr) will also not be exceeded. The IDC is a measure of the effective dose of radiation the human body may receive from drinking water. The values are based on the International Commission on Radiological Protection (ICRP), a partner of UNSCEAR, as Armenia does not have drinking water IDC standards.

Routine groundwater and/or surface water samples were obtained from sample points around the Amulsar vicinity in 2008, from July 2011 to April 2012, and in 2015. The levels recorded in the majority of samples did not exceed the WHO guideline values for gross alpha (0.5 Bq/l) and gross beta (1.0 Bq/l) levels. However, in March 2012 in surface water, exceedences of the gross alpha and beta levels were recorded at 0.64 Bq/l (sample DWJ-9) and 2.58 Bq/l (sample DWJ-8) (see Section 4.9).

Mitigation Measures

Dust

The results of the radiological risk assessment indicate that no potential impacts to the surrounding communities are expected as a result of Project operations, in terms of radiological risk. Potential impacts to Project workers are considered to be related to standard risks associated with dust generation (see Section 6.1) and limited to within a 1-km radius of the major dust generating sources. Potential fugitive dust impacts will be mitigated as described in Section 6.6.

Radon

Mine buildings will be adequately ventilated and will incorporate measures to reduce potential radon gas accumulations. Radon reduction measures normally consist of gasimpermeable membranes to prevent radon from seeping into buildings or pumps to remove radon from occupied areas, again preventing any build-up of radon gas. It is unlikely that pumps would be required, especially where active dust extraction systems are present, so simple radon protective barriers will be installed in all buildings. Suitable barriers include 300 µm (1200 gauge) polyethylene (polythene) sheets, prefabricated welded barriers, or self-adhesive bituminous-coated sheet products. Installation of radon barrier products will be supervised by a suitably qualified and experienced engineer to verify that welds and joints are adequately sealed.

Radon monitoring of basements or ground floor indoor areas, will be carried out to validate the protection measures. If these measures are employed, it is considered that the radon risk to Project workers will be reduced to neutral.

The cause and extent of elevated radon concentrations in village dwellings has not been fully ascertained, however it is a pre-existing condition for the villages and is not linked to the Project's activities. Building materials, design, and ventilation systems strongly influence indoor levels of radon.

Given that radon concentrations in village dwellings are known to be high, Lydian could consider working with the villages and local administration to alleviate this issue as part of their community development programme.

Drinking Water Monitoring

The sources of water used for irrigation and potable purposes by members of the public are outlined in Section 4.9. The cause and extent of elevated gross alpha and beta concentrations in surface water needs to be ascertained by additional monitoring of water sources used by the public in the Project area, and will be monitored prior to construction and thereafter.

The summary of impacts is shown in Table 6.18.7.

Table 6.18.7: Qualitative Impact Assessment of Radionuclides (dust and radon) to Human Receptors at Amulsar Mine

Type of Radiation	Receptor Group	Sensitivity of Receptor	Type of Exposure (internal/external)	Frequency/Duration of exposure	Likelihood of Exposure	Dose/Severity of Consequence
Radionuclides in fugitive dust	Workers	High	Internal (inhalation)	Regular/Limited Duration	Low to Medium (occasional/very infrequent to periodic)	Negligible (within accepted dose limits)
	Public (herders and/or villagers)	High	Internal (inhalation)	Rare /Limited	Very Low	Negligible (within accepted dose limits)
Radionuclides in radon gas	Workers (at infrastructure & dormitories)	High	Internal (inhalation)	Occasional/Short Duration	Low (occasional/very infrequent)	Minor/Localised
	Public (herders and/or villagers)	High	Internal (inhalation)	Exceptional circumstances/Limited Duration	Very Low (unlikely)	Negligible to Minor/Localised
Radionuclides in water (via dust)	Drinking water users	High	N/A	Occasional/Limited Duration	Low (occasional/very infrequent)	Minor/Localised

Food Chain Risks

Introduction

This assessment has been undertaken in response to stakeholder concerns regarding the potential impacts of dust generation from the proposed Amulsar Project on herders who graze cattle in the vicinity of the proposed mine site. The results of a quantitative assessment of the risks to herders and their cattle from the uptake of metal contaminated dust are summarised here. The assessment of potential uptake through apricot orchards will be undertaken during the construction period.

The purpose of the Human Health Risk Assessment (HHRA) is to predict whether metals present in dusts represent an unacceptable risk to human health via direct and indirect exposure pathways. The potential risk to the health of cattle from metals in dusts has also been assessed.

Composition and Distribution of Mine Dust

The composition of dust from the primary elements of the mine infrastructure has been estimated based on chemical analysis of more than 20,000 samples of ore rock and more than 50,000 samples of barren rock from the proposed Project. Estimated mean dust composition for barren rock and ore is shown in Table 6.18.8.

The distribution of dust in the area surrounding the mine has been predicted through modelling of dust deposition as a function of emission rates and distance from point sources at the operational facilities (Chapter 6.6). The findings showed that the maximum dust deposition rate 815m from a source was approximately 133mg/m^2/day, with fallout concentrations dropping off to negligible levels 1km of the most significant point source in the direction of the prevailing wind. The rate of dust deposition surrounding the operational pit, crusher plant, haul roads, HLF and BRSF calculated in Chapter 6.6 is shown in Figure 6.6.3. The majority of dust deposition occurs surrounding the haul roads, the open pit, crusher plant, and truck loadout facility.

Table 6.18.8: Summary of Dust Composition			
Dust emissions from:		**Barren Material**	**Ore Material**
Estimated metal concentration In dust emission	Au ppm	0.05	1.02
	Ag ppm	1.63	4.29
	As ppm	115.02	320.06
	Cd ppm	0.27	0.26
	Cr ppm	25.41	25.08
	Ni ppm	6.41	5.88
	Pb ppm	125.73	240.72
	S %	1.57	0.78
	Sb ppm	36.65	145.37
	Th ppm	16.43	12.34
	U ppm	5.31	5.47
	Zn ppm	16.62	12.63

Calculation of Metal Concentrations in Soil from Dust

It is reasonable to assume that as a result of wind action and rainfall, dust falling surrounding the mine will become mixed into the upper few centimetres of the soil column. For the purposes of this assessment, it has been assumed that this mixing occurs to a depth of 2 cm. Dust deposits at a rate greater than 1mg/m^2/day into an area transcribed roughly within a 1km buffer from the active facilities during the life of mine. This information has been provided by WAI (2012). Maximum concentrations in the upper soil layer within 1 km of the mine have been determined through calculation of soil concentrations within each distinct area for which a dust deposition rate was calculated (Figure 6.6.3) as follows:

$$C_f = \frac{D_M L}{D_T L + \rho t A}$$

Where C_f (mg/kg) is the final soil concentration at the end of mine operation, DM is the deposition rate of metals during operation calculated for the specified area (g/day), DT is the deposition rate of metals during operation for the specified area (kg/day), L is the mine life (days), A is the area under consideration (m^2), t is the depth of soil in which dust mixing occurs (m) and ρ is the dry density of the soil in which mixing occurs (kg/m^3). The spatially averaged soil concentrations within the 1 km zone are shown in Table 6.18.9.

Table 6.18.9: Weighted Average Soil Concentrations (mg/kg)											
Gold	**Silver**	**Arsenic**	**Cadmium**	**Chromium**	**Nickel**	**Lead**	**Sulphur**	**Antimony**	**Thorium**	**Uranium**	**Zinc**
0.01	0.066	4.75	0.01	0.63	0.16	3.92	311.17	1.96	0.36	0.13	0.39

Risk to Cattle from Metals in Dusts

Method

The assessment of risk to cattle was undertaken by comparing metal concentrations in surface soils with ecological screening values sourced from:

- United States Environmental Protection Agency (US EPA) Ecological Soil Screening Levels (*http://www.epa.gov/ecotox/ecossl/*) which were accessed on 24 July 2012; and
- Environment Agency of England and Wales (EA) Ecological Soil Screening Values.

Results

None of the concentrations of metals in soils exceed published US EPA or EA ecological screening values. Based on this Tier 1 assessment, concentrations of metals in soil do not present an unacceptable risk to cattle.

Risk to Human Health via direct Exposure Pathways

Method

The assessment of risk to human health from direct exposure pathways, such as soil and dust ingestion, dermal contact with soil and dust inhalation, was undertaken by comparing metal concentrations in surface soils with conservative health based screening values, considering a residential land-use scenario, sourced from:

- USEPA Regional Screening Levels database (*http://www.epa.gov/region9/superfund/prg/*), last updated in May 2012 and accessed on 24 July 2012; EA Soil Guideline Values; and Generic Assessment Criteria developed using the approach and software published by the EA.

Results

With the exception of arsenic, none of the soil metal concentrations exceed published US EPA or EA screening values for a residential land-use scenario. The concentration of arsenic of 4.81 mg/kg exceeds the USEPA screening value of 0.39 mg/kg but is below the EA screening value of 32 mg/kg. Using screening values for residential soils represents a conservative approach;

for example, the residential scenario assumes exposure occurs 365 days/year and exposure is for a 6 year old child. The soil concentration of 4.81 mg/kg is unlikely to present an unacceptable risk to human health in the context of land-use in the study area; however, arsenic was selected for further assessment using a multi-pathway approach which is discussed below.

Risk to Human Health via Multiple-pathways

Method

Four metals (arsenic, antimony, lead and trivalent chromium) were selected for further assessment using a multi-pathway approach. These metals were selected on the basis of their toxicity and soil concentration. The multi-pathway assessment considered the following indirect exposure pathways:

- Uptake of metals from soil into above ground produce which is eaten by cattle;
- Uptake of metals by an adult and child farmer by eating beef from cattle which have fed on contaminated above ground produce;
- Uptake of metals by an adult and child farmer by drinking milk from cattle which have fed on contaminated above ground produce; and
- The uptake of metals by an adult and child farmer through accidental ingestion of soil was also included in the multi-pathway assessment to provide a conservative assessment of exposure.

The multi-pathway HHRA predicts chronic exposure to contaminants in soil. The methodology used to perform the modelling is the internationally recognised HHRA Protocol (HHRAP) for Hazardous Waste Combustion Facilities, published by the United States Environmental Protection Agency in 2005 (US EPA HHRAP, 2005). The HHRAP has been reviewed by 58 Environmental Protection Agency experts, 18 external State Reviewers and 9 external Scientific Peer Reviewers.

The multi-pathway assessment predicts the total daily intake of each metal from each exposure route. Toxicological or health effect values are used to benchmark the predicted exposure levels. Toxicological values for use in the HHRAP were sourced from the US EPA Regional Screening Levels database i.e. Reference Doses (RfD_{oral}) and Cancer Slope Factors (CSF_{oral}).

Results

The risk from non-carcinogens (antimony, lead and trivalent chromium) was assessed by deriving a hazard quotient (HQ). A HQ is derived for each metal and is the comparison of metal-specific total daily exposure to the metal-specific toxicological value. The likelihood of unacceptable risk to human health increases if the HQ is greater than 1 and the risk is acceptable if the HQ is less than 1. The highest HQ derived for the multi-pathway assessment scenarios was an adult farmer exposed to antimony, with a HQ of 0.161.

For carcinogens (arsenic) risk estimates represent the incremental probability that an individual will develop cancer over a lifetime as a result of a specific exposure to a carcinogenic chemical. Excess cancer risks that range between 1×10^{-6} and 1×10^{-4} are generally considered to be acceptable by the US EPA. Predicted excess cancer risks for the multi-pathway assessment scenarios for arsenic of 5.53×10^{-5} and 9.65×10^{-5} are within this range.

Based on the modelled exposure scenarios, concentrations of metals in soils do not result in an unacceptable risk to identified receptors (adult or child farmers) within the study area.

Conclusions

Based on the results of the human health and ecological (cattle) risk assessment **negligible** risks have been identified either to cattle grazing or to herders working in the vicinity of the Project site. Further studies will be completed to assess the impacts associated with apricot orchards, but they are not expected to be significant.

Safety Risks Associated with Earthquakes and Blasting

Earthquake Impact Assessment

The Project is located within a seismically active region and there are detailed records of historical seismicity available. A number of potentially active fault systems have been identified around the site that could generate these earthquakes and a Probabilistic Seismic Hazard Assessment (PSHA) has therefore been undertaken for the Project (see Section 4.6).

The principal impact of earthquakes on the Project facilities arises from the propagation of seismic waves through the rock mass and soil cover. These waves can cause deformation of unconsolidated materials, such as waste rock and heap leaching facilities, and decrease the stability of slope profiles by inducing dynamic loading to the normal static conditions. Such deformation and loading could cause instability to occur and consequent failure of the facilities.

The historical seismicity and geological setting have been used in the PSHA in order to determine the potential activity along the fault systems that could generate earthquakes. This has enabled the Peak Ground Accelerations that could occur at the open pit, crusher site, waste dump and heap leach facility to be calculated.

The Barren Rock Storage Facility (BRSF) and Heap Leach Facility (HLF) have been analysed to determine the degree of stability under normal static conditions and with the induced loading caused by Peak Ground Accelerations (PGA) calculated in the PSHA. The operational phase of these facilities has been assessed using an Operating Basis Earthquake (OBE) with a 10% probability of exceedance in 50 years (equivalent to a return period of 475 years). The closure phase of the facilities has been assessed using a Maximum Design Earthquake (MDE) with a 2% probability of exceedance in 50 years (equivalent a return period of 2,475 years).

The slopes have been designed to be stable under the PGA loading induced by these earthquakes using criteria that provide an acceptable engineering standard of care for the industry.

Most buildings in Jermuk were constructed prior to the application of the Armenian Seismic Code. Structural compliance with this code is being assessed as part of the accommodation selection process for construction and operations.

Blasting Safety in a Seismically Active Zone

Blasting technologies and technics rarely produce energy outputs that exceed the energy of natural earthquakes on a global scale, however in some cases, the regional contribution to seismic energy release by blasting operations is by a few orders of magnitude higher than the energy released by natural earthquakes.

Thus to prevent the seismic effect of the blast, a Blast Management Protocol will be developed to evaluate the method of sequential blasting to be undertaken. In order to manage the energy released from blasting activities the spatial distribution of explosive activities will be considered, the consumption of explosives is calculated, the technology of short-delay mass explosions evaluated. The use of short-delay blasting increases the intensity of fragmentation of the rock by the blast, reduces disruption of the rock mass outside the crushing zone, provides localised disintegration of the rock mass, and decreases the seismic effect of the blast. Zoning the regional seismic zones in terms of the release rate of seismic energy and the peak local magnitudes observed when blasting activities blasting operations are undertaken. This would be undertaken to demonstrate that the hazard level associated with blasting activities does not exceed the corresponding parameters of seismic zoning.

6.18.12 Social Determinants of Health

Project Activities Affecting Social Determinants of Health

The main social determinants of health relevant to the Project include employment and local economic development, wellbeing linked to quality of lives and inequalities, general social cohesion as well as Project expectations. These topics are covered in the social impact assessment in Sections 6.13, 6.14, and 6.15, but some health specific areas are discussed below.

Potential Impacts from Social Determinants of Health

It is anticipated that impacts related to local employment and economic development will be felt in the medium term, be restricted to the study area, and have a minor beneficial health effect. It is possible that these health consequences will occur, representing an overall **moderate beneficial health impact significance**. The impacts are anticipated to initiate in the construction phase, and extend into the operational period. The communities of Jermuk, Gndevaz, Saravan and Gorayk are likely to benefit most from this. Without specific mitigation measures, men are more likely to benefit than women.

To maximise these potential benefits, the PACs will need to support initiatives through effective community cohesion, with assistance from the Marz and local government authorities. The potential extended benefits may improve livelihoods and perceptions of well-being, as well as allow for the ability to afford local services (such as health care) which may promote better life styles and health seeking behaviour. The potential benefits may include:

- Although it will not be a major employer, there is the opportunity for some of the local community to be employed by the Project. The Project promotes local employment and will implement a training programme to enhance the likelihood of local residents being eligible for jobs on the Project. To promote gender equality and to reduce potential impacts on local women they should be eligible and enrolled in these training programmes and be considered for employment.
- The presence of the Project may stimulate the local economy and create multiplier effects through linkages of potential supply and service companies in the study area. Economic upliftment may further stimulate local investment and development opportunities and even generate interest from donor funding and even improved

government commitments. Gender equality is considered in the economic development programmes.

- The improved services and access that may occur in the study area has the potential to improve local tourism and even create the establishment of secondary businesses.

However, a number of potential negative social health impacts may be indirectly associated with the Project, including:

- Potential impacts on social cohesion and emergence of social issues such as breakdown of family structures, crime, domestic violence and substance abuse as a result of in-migration (of workforce and opportunistic migrants) and altered economics/demographics;
- Unmet expectations of anticipated benefits from the Project, including employment, economic benefit and a better quality of life.

Mitigation/Enhancement Measures for Social Determinants of Health

Project Impact Mitigation:

- Mitigation actions are discussed in the ESIA, with the key opportunity in supporting local economic development that should result in an improved quality of life and perceived well-being of the PACs; and
- Effective communication strategies to manage expectations and perceived impacts from the Project will be important to address at the local level.

Social Development Mitigation and Management:

- Promote improved community cohesion in the PACs so that self-regulation of potential social ills is promoted. These can include promotion of healthy lifestyle activities or sporting events etc.

Residual Impacts on Social Determinants of Health

Through enhancing the management of social determinants, the residual benefits will be **moderately beneficial health impact significance**, but in the longer term and with greater probability.

6.18.13 Cultural Health Issues and Health Seeking Behaviour

Project Activities Affecting Cultural Health Issues

Health seeking behaviour in the community is affected by the affordability and acceptability of the local health services. The Project is unlikely to negatively impact on the local health infrastructure or programmes but may in fact support mechanisms to improve delivery of health care in the study area. Due to the influence of cultural health practices and importance of traditional medicine (TM) the activities of the Project are unlikely to impact meaningfully on the prevailing local health seeking behaviour. However, the following potential impacts are considered:

- The development of the Project may reduce access to areas that the community utilises to collect medicinal plants. This is assessed as part of the ecosystem services impact assessment in Chapter 6.19.
- A potential positive impact of the Project may be the indirect improvements in health care delivery, which may promote better health seeking behaviour and better disease prevention and control. This is challenging to predict or quantify.

Potential Cultural Health Issue Impacts

It is anticipated that impacts related to cultural health will be felt in the long-term, be restricted to the study area, and have no meaningful health impact past the current baseline. It is unlikely that these health consequences will occur, representing an overall **minor negative health impact significance.** The impacts are unpredictable, may occur at any time of the Project life cycle, and could affect Gndevaz, Gorayk/Saravan and Jermuk PACs. Gender specific impacts are not anticipated.

Mitigation Measures for Cultural Health Issue Impacts

This impact is considered minor and does not require extensive mitigation other than evaluating the access to local herbs and plants that may be used for medicinal purposes on the Project site. Supporting health systems strengthening to improve health seeking behaviour through improved access to affordable and acceptable local health services will be a useful social development initiative that may serve as an overall health benefit.

Residual Cultural Health Issue Impacts

The short and long term residual cultural health issue impacts are negligible, but if social development initiatives are developed these may result in a moderate beneficial health impact significance.

6.18.14 Health Systems Issues

Project Activities Affecting Health System Issues

The Project will build and maintain an infirmary at the mine, which will be staffed with a paramedic at a minimum. Occupational health and emergency care/first aid requirements will be managed through this service delivery option. This will be addressed in more detail as part of the occupational health and safety management plan.

Potential Health System Impacts

It is anticipated that impacts related to health service infrastructure and health programme delivery will be felt in the medium-term, be experienced at the study area, and cause a moderate negative health impact. It is possible that these health consequences will occur, representing an overall moderate negative health impact significance. The impacts could affect Gndevaz, Gorayk/Saravan and Jermuk PACs. Gender specific impacts are not anticipated unless access to health care is altered for maternal and child health care services.

The Project has the potential to impact the national/ local health service infrastructure and delivery mechanisms in the following ways:

- **In-migration:** In-migration and an increased population have the potential to exceed the capacity of the available health care services, especially in Jermuk. This is however likely to be limited in terms of infrastructure as the health services in the area are under-utilised at present. However, in terms of institutional and human resource capacity this may induce a significant impact as there is minimal capacity to support this potential growth, from a planning, budget or a delivery perspective. As rapid in-migration is not anticipated to occur this impact may be limited, but careful monitoring and anticipation of impacts will be important.
- **Workforce health requirements:** The Project is developing primary, occupational and emergency care facilities to serve the needs of the workforce. The health facilities in the area have minimal capability to address occupational and emergency care, so these will need to be developed and maintained on site. However, there is an opportunity for the Project to utilise the available public health services for basic

primary health care recognising that this should not reduce accessibility for the local community. This could represent a win-win situation, as the Project will receive access to suitable medical care for its staff and the payments levied for this service could support refurbishments and improvement of services to the benefit of the broader community. However, this will need to be carefully planned and the model developed in consultation with the government. It is essential that the Project is not viewed as the de-facto Ministry of Health in this area but merely a customer seeking services of the correct quality in the correct place to the benefit of the broader community.

- **Health service inequalities and Project expectations:** There is the potential for inequality, or perceptions of inequality to develop, between different communities because of Project supported health initiatives. It is thus essential to plan equitable support in this sector to avoid potential criticisms. There may be an expectation on the Project to support or supplement the delivery of health care services in the study area, but as mentioned above any corporate social investment activities or activities aimed at reducing impacts through health systems strengthening must be done in partnership with the local and national authorities and the delivery should be tasked to entities other than Lydian.
- **Health management information systems (HMIS):** While this is not a direct health impact from the Project, the limited HMIS restricts the ability to effectively monitor health impacts based on secondary data collected from the health facilities. This can pose a risk to the Project, as the available data sources to monitor health impacts will be limited.

Mitigation/Enhancement of Health System Impacts

The following mitigation and enhancement activities have been identified:

Project Impact Mitigation:

- Monitor the demographic changes in the immediate Project area and work with local health authorities to determine if the available health facilities are adequate for the needs of the community. This will require constant surveillance so that any impacts on health services can be anticipated at an early stage. In addition, this will require support from the planning section of the Ministry of Health.
- Support the development of a CHIS using longitudinal data from the local health services. A basic health database should be developed to track indicators from both primary and secondary forms of data and be used to monitor for both impacts as well

as the success of interventions and assist in the planning of interventions with the local authorities.

- Develop effective communication strategies on the role and responsibility of the Project in supporting health care service delivery in the study area.

Occupational Health, Safety and Environmental Management:

- Ensure that the Project health services can adequately cater for the needs of the workforce in terms of occupational health and emergency care.
- Evaluate the potential to utilise the available primary health care services to serve the needs of the Project. This needs to be done carefully to limit the risk of inducing a health impact through reduced capacity to cater for local health care needs, or inequalities to patients unrelated to the Project.

Social Development Mitigation and Management:

- Seek opportunities to collaborate with donor agencies or NGOs to improve health care services in the broader area. These should be managed and run separately from the Project, but the Project can consider elements of support. This will build on existing programmes being undertaken with Oxfam, other NGOs and their partners.

Residual Health System Impacts

Effective and sustained implementation of the mitigation measures described above is anticipated to generate a neutral/negligible health benefit in the study area. It is possible that these changes will occur, with the likelihood that they are experienced in the medium term and in the study area. This represents an overall negligible/minor beneficial health impact significance to the health system.

6.18.15 Accidents and Injuries

Project Activities Affecting Roads Traffic Accidents and other Accidental and non-Accidental Incidents

The Project will increase the amount of traffic on the H-42 to Jermuk and along the M-2 towards Vayk, and to a lesser extent Saravan/Gorayk and a number of other routes along the supply chain route from Yerevan. Jermuk and Gndevaz are likely to be most impacted by an increase in road traffic, either directly or indirectly related to the Projects activities. Traffic related impacts are discussed in a separate chapter.

The Project could also generate increased levels of violence associated with crime through changing the social fabric of the communities as discussed in Section 6.12.

Potential Traffic Accidents and other Accidental and non-Accidental Incidents Impacts

It is anticipated that impacts related to accidents and injuries will be felt in the long-term, be experienced at a regional level, and cause a moderate negative health impact. It is probable that these health consequences will occur, representing an overall major negative health impact significance. These potential impacts could occur in all five of the identified PACs.

The Project has the potential to influence accidents and injuries in the following direct and indirect manners:

Direct:

- **Transport Corridors:** The development and operation of the Project will increase road traffic in the immediate study area as well as the transport corridors to Yerevan and potentially to Georgia. This will include the transport of goods and personnel to service the needs of the Project. This can include long distance truck hauling and use of light duty vehicles, which may increase the risk of road traffic accidents (RTAs) along the route. General transport issues are addressed on the Transport Management Plan (Appendix 8.10) and the transportation of cyanide is addressed in the Cyanide Management Plan (Appendix 8.11) developed as part of the ESIA and are not specifically addressed in this chapter.
- **Heavy mobile mining equipment:** There should not be any community exposure to heavy mining vehicles as the proposed mining area is located outside of any human settlements. In addition, there should be no interaction with heavy mining vehicles, as the mining area will be secured and the haul roads will not be open for public use.

Indirect:

These can relate to RTAs as well as non-accidental injuries due to social pathologies and include:

- Improved economy in the area may allow more people to be in a position to afford motorised transport. This will result in increased numbers of motorised forms of transport on the road with the potential for accidents and injuries.
- Change in the social structures in the area due to potential migration, change in local practices and potential for social decay. Crime and associated violence may increase as part of these potential social pathologies.

Mitigation/Enhancement Measures for Traffic Accidents and other Accidental and non-Accidental Incidents

Project Impact Mitigation:

- Develop community security and safety management plans for the Project based on a risk assessment of planned activities. This should include emergency preparedness and response plans for both community and workplace related accidents. This must include a fire, rescue and chemical spill response capability, as well as medical emergency preparedness and response.
- Develop a clear policy for the management of emergencies or accidents in the community as a direct result of the Project's activities as part of the community security and safety management plans.
- Mitigation measures as described in the traffic and transport impact assessment specialist report.
- Support the surveillance of RTA and non-accidental injuries (assault) in the proposed CHIS.
- In-migration management and protection of social structures and cohesion where possible.

Occupational Health, Safety and Environmental Management:

- Management of mobile equipment and machinery within the framework of the Projects occupational health and safety management plan.
- Maintain appropriate emergency preparedness and response capabilities at the Project.
- Strictly enforce the drug and alcohol policy for all work related vehicles- including contractor transport vehicles.

Social Development Mitigation and Management:

- Work with local authorities and law enforcement authorities in the area to promote adherence to road traffic laws and to inform community members of the legal speed limits.

Residual Traffic Accidents and other Accidental and non-Accidental Incidents Impacts

Through implementing the measures outlined above the short term residual impact is considered to be **moderately negative,** and the long-term impact, neutral.

6.18.16 Security Conflicts

Project Activities Affecting Security Conflicts

The Project will employ a number of security guards during construction and operations to protect its assets and ensure un-authorised access to facilities does not occur.

Full details of the security arrangements for the Project will be prepared as part of the Project Execution Plan as well as in a specific Security Plan being developed. High-risk facilities, such as the ADR plant and explosives magazine, will have an enhanced security presence to prevent any loss of the doré product and access to explosives used in mining. Security guards working at the ADR and transporting the doré product are expected to be armed.

The Project currently employs a local security contractor to protect the exploration activities. In addition, a contract has been signed with the Armenian police who have established control points on the access roads to the Project area, restricting unauthorised access.

Potential Security Conflict Impacts

It is anticipated that impacts related to security conflicts will be felt in the short and medium-term, be experienced at the local level, and cause a moderate negative safety impact. It is probable that these safety consequences will occur, representing an overall major community safety impact significance. These potential impacts could occur in Gndevaz, Gorayk and Saravan PACs.

The use of private and public security guards by the Project has the potential to create the following impact:

- Inappropriate use of force – Where tension exists between a Project and host communities, the presence of security guards can escalate that tension. If the security guards have not received appropriate training, they may resort to inappropriate use of force to manage conflict. This issue is even more important where security guards are armed. In the worst case scenario, this can lead to human rights abuses.

Mitigation Measure for Security Conflict Impacts

The Project will apply the following mitigation measures:

- Lydian is becoming a signatory of the Voluntary Principles on Security and Human Rights. As part of this commitment, a risk assessment is being undertaken to minimise the security and human rights risks created by the Project. A full review of the security arrangements put in place will be conducted.
- Security contracts will be awarded to local companies where possible to minimise the risk of creating unnecessary tension between host communities and security guards.
- Access to grazing and pasture land will be maintained wherever possible, while maintaining security of the Project facilities and safety of employees and community residents.
- A Memorandum of Understanding will be developed with the Armenian Police to establish the use of force, which is appropriate for the protection of the site assets and personnel.
- Armed guards will be used to protect the *doré* product and to secure the explosives magazine. Effective training will be provided and their performance monitored closely.

Residual Security Conflict Impacts

Through applying the Voluntary Principles on Security and Human Rights and the other measures outlined above, it is considered that security conflict impacts would be **minor negative** in the short term and negligible in the long-term (see Table 6.18.10).

Table 6.18.10 summarises Project impacts on Community Health and Safety.

Table 6.18.10: Impact Summary – Community Health and Safety

Sub-category	Direction	Extent	Duration	Impact (prior)	Impact (post)
Communicable disease linked to the living environment	Negative	Local	Medium term	Moderate (negative)	Negligible
Vector related disease	Negative	Local	Short term	Negligible	Negligible
Soil, water and waste related diseases	Negative	Local	Medium term	Moderate (negative)	Minor (negative)
High risk sexual practices, STIs including HIV/AIDS	Negative	Regional	Long term	Very High (negative)	Moderate (negative)
Food and Nutrition	Negative	Local	Short term	Minor (negative)	Negligible
Non-communicable diseases	Negative	Local	Long term	Moderate (negative)	Moderate (Positive)
Environmental health determinants	Negative	Regional	Medium term	Major (negative)	Negligible
Social determinants of health	Positive	Local	Medium term	Moderate (Positive)	Moderate (Positive)
Cultural health practices	Negative	Local	Long term	Minor (negative)	Negligible (Moderate positive if social development initiative are implemented and successful)
Health services and systems	Negative	Local	Medium term	Moderate (negative)	Minor/Negligible (positive)
Injuries and accidents, including road accidents	Negative	Regional	Long term	Major (negative)	Moderate (negative)
Security conflicts	Negative	Local	Short - Medium term	Major (negative)	Minor (negative)